

Veridicality Annotations in Spanish

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Abstract

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In veridicality studies, an area of research of Natural Language Inference (NLI), the factuality of different contexts is evaluated. Here, we aim to reduce the lack of research in this field, particularly in Spanish, by presenting the analysis of annotations collected in a pilot study for two different contexts, mood alternation and specificity. Results show a inter-annotator agreement score of $AC_2 = 0.484$, slightly lower than that of de Marneffe et al. [1] ($\kappa = 0.53$), a main reference to this work. Furthermore, a significant effect of some mood alternation conditions, and a few unexpected tendencies, like high factuality despite the presence of a negation marker, were found. Finally, suggestions that could explain the lack of inter-annotator agreement as well as improve it for the final study are defined. The annotations collected are available on https://github.com/narhim/veridicality_spanish.

Acknowledgements

Thx Mom+Dad < 3

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Dedicated to WHATEVER.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Is that true? Did it really happen? Often we ask ourselves or our interlocutors these questions, we try to assess if the information conveyed is likely to be truthful or not, that is, if it is presumably a fact or not. Also, as speakers or authors we usually try to portray what we know about the truthfulness of the events conveyed. But, how do we do these operations? There are different linguistic factors at play, like the use of negation or modality markers, and their study is what is called veridicality, research topic for this thesis.

To be more specific, veridicality is an area of research within natural language inference (NLI) and theoretical linguistics that studies the truth value of a proposition or event in a specific context [2, 3]. As to NLI, it is a branch of natural language understanding (NLU) with its main task being entailment classification, that is, given a premise like *He believes her father has arrived*, and a hypothesis like *Her father hasn't arrived*, the task is to classify the relationship between them by picking a label from a usually small set of labels like {*entailment, neutral, contradiction*} [4] or {*yes, unknown, maybe*}, depending on how the task is defined. For a system to successfully complete this task, it needs to form a thorough and complete meaning representation of both sentences [4], and here is where veridicality, among other disciplines, comes into play.

The focus of thesis is the analysis of veridicality judgments in Spanish; that is, the analysis of factuality judgments in specific contexts in Spanish. In particular, the goal is to analyze how mood alternation, in other words, the possibility of using a verb either in indicative or subjunctive mood; and the specificity of the syntactic subject affect factuality judgments. This goal is realized in the following research questions:

- RQ1.- In a complex sentence, how does the mood alternation of the embedded verb that occurs due to the negation of the main or matrix verb affect the factuality value of the embedded event?
- RQ2.- In a simple sentence, how does the mood alternation caused by an adverb of doubt or possibility affect the factuality judgment of the event?
- RQ3.- How does an individual subject affect the factuality judgment of the event?
- RQ4.- How does a subject that refers to a collective entity like an institution, affect the factuality judgment of the event?

In order to answer these questions and verify their relevance, I run a pilot study in which annotations for a small corpus were gathered. Based on the results of this study, introduced in Chapter 3, some modifications were made for the final study, the most important being the removal of research question RQ2.-. Thus, for the main or final study the research questions are the following:

- RQ1.- In a complex sentence, how does the mood alternation of the embedded verb that occurs due to the negation of the main or matrix verb affect the factuality value of the embedded event?
- RQ2.- In a simple sentence, how does the mood alternation caused by an adverb of doubt or possibility affect the factuality judgment of the event?
- RQ3.- How does an individual subject affect the factuality judgment of the event?
- RQ4.- How does a subject that refers to a collective entity like an institution, affect the factuality judgment of the event?

The main motivation behind this thesis is to try to reduce the lack of research in veridicality, specially in Spanish, that I have encounter. To my knowledge, most of the research in veridicality, in any language, is often either done from a purely thereotical perspective or completely absorbed by the term factuality, thus making it difficult to find research in veridicality from a natural language processing (NLP) perspective. Furthermore, as is often the case in any NLP area, it seems that most of the datasets available for NLI are in English, thus carefully creating and making available an annotated dataset in Spanish could help better understand veridicality contexts in Spanish and also further develop NLI systems for Spanish, and maybe even related languages.

Next, Chapter 2 introduces the literature review and the explanation of the main concepts used here. Then, Chapter 3 presents the already mentioned pilot study and then the main study is introduced in Chapter 4. Finally, Chapter 5 brings together all the issues discussed in each experiment, suggests possible improvements, and proposes some lines of future work.

CHAPTER 2

BACKGROUND

The goal of this chapter is to clarify the most important terms that will be used in this thesis, give theoretical support for the claims made for the experiments, and present some previous research important to the study here. Specially the focus is on distinguishing concepts that are often confused, like veridicality and factuality, and introducing the reader to the phenomena in Spanish linguistics on which this thesis focuses.

First Section 2.1 clarifies the difference between veridicality and factuality, provides specific work on each of them, and explains the two main approaches used to study these concepts. Secondly, in Section 2.2, the first experimental condition in this thesis will briefly explained, mood in Spanish, together with the specific mood contexts set as experimental conditions. After this, in Section 2.3 the second experimental condition, specificity, is introduced, together with the particular specificity contexts whose veridicality is here analyzed.

2.1 Veridicality and Factuality

Let us consider examples (1a) to (1d), where we have events that are intrinsically related. If we were to do a NLI study with these examples, we could directly study the *truthfulness* of each of them as a single event, i.e., we could study the **factual nature** of each example towards the real world or the events in the discourse [5]. Another option would be to study the factual nature of the event *Anna's father has arrived* in the different contexts in which is presented: standing completely on its own (1a), or as part of a complex event (1b) to (1d). In this case, the goal would be not to understand the factuality of *Anna's father has arrived*, but rather to understand how its factuality changes when the event is embedded under an epistemic verb (1b), a verb of believe

(1c), and a verb of speech (1d). This would be considered a **veridicality study**, and the former case, a factuality study.

- (1) a. Anna’s father has arrived.
- b. John knows that Anna’s father has arrived.
- c. John believes that Anna’s father has arrived.
- d. John says that Anna’s father has arrived.

Probably one of the most important studies in NLI with a factuality focus is that of Williams et al. [4]. They extended the work of Bowman et al. [6], which presented a NLI corpus where the premises were crowdsourced figure captions and hypothesis were also crowdsourced, by increasing the number of genre to a total of 10: transcribed conversations, official documents, letters, the public report of 9/11, non-fiction works, popular cultural articles, telephone transcriptions, travel guides, short posts about linguistics, and fiction works. This corpus, denominated as MNLI or Multi-NLI, uses the labels $\{\textit{entailment}, \textit{unknown}, \textit{contradiction}\}$ and is now an important benchmark in NLI, as proven, for example, by its use to test BERT [7]. From this corpus originates the XNLI corpus [8], which consists on translations of the MLNI corpus into different languages, including Spanish. As we will see on Chapter 4, a small subset of this corpus was used in the main study.

Another important work in NLI is the FactBank corpus [5], which consists on 9,488 manually annotated events by experts which resulted in the FactBank corpus. It can be said that it is done from a factuality focus, since it does not include a systematic analysis of different contexts, but it is true that the authors present an extensive analysis of the different factors that affect the factuality of an event, that is, they present a theoretical veridicality analysis. Another important feature of their work is their set of labels, which is the baseline of the one used here, and which results from the combination of an epistemic scale, $\{\textit{certain}, \textit{likely (probable)}, \textit{possible}\}$, with a quality scale, $\{\textit{positive}, \textit{negative}\}$. They map this combination to the traditional Square of Opposition, but for the sake of simplicity, here this square is reduced to a linear scale of factuality, as we will see later on. In any case, the labels they used are the following: *certainly yes* (CT+), *probably yes* (PR+), *possibly yes* (PS+), *certainly not* (CT-), *probably not* (PR-), *possibly not* (PS-), *unknown or uncommitted* (Uu), and *certain but unknown output* (CTu).

An interesting factuality study is that of Pavlick and Kwiatkowski [9]. Their goal was to determine whether the disagreement often seen in NLI datasets is noise or a reproducible signal, and thus it should be included in data analysis and modelling. To fulfill this goal, they collected factuality judgments on 500 pairs from different corpora and with 50 annotators per pair. But after filtering the annotations, 496 pairs with a mean of 39 workers per pair were left to analyze.

When analyzing the annotations, the authors assumed that if the disagreement is noise, the gathered labels can be modeled as a simple Gaussian distribution where the mean is the true label and, consequently, there is only one true label. To verify this assumption, the authors fixed two models for each pair: one single Gaussian and a Gaussian Mixture Model (GMM) where the number of components is chosen during training. Results showed that overall there was a better fit with GMMs and that for 20% of the pairs there was a nontrivial second component, that is, that for 20% of the pairs there is not just one *true* label, but rather two. This phenomenon can be referred to as **label split** [1] and might be helpful in explaining the results obtained in the main study here.

Furthermore, Pavlick and Kwiatkowski [9] analyzed whether context reduces disagreement by collecting annotations at three levels: word, sentence, and paragraph. Results showed that disagreement increases with context, which the authors interpret as first evidence that agreement does not improve with more context. They explain this by hypothesizing that less context may result in higher agreement because with less context humans can more easily call upon *default* interpretations. Although context was not included in either of my studies, the work of Pavlick and Kwiatkowski [9] will help on the discussion of the results.

A clear example of a study on veridicality is that of Ross and Pavlick [10]. Their goal was to learn whether neural models with no explicit knowledge of verbs' lexical categories can make inferences about veridicality consistent with human inferences. To do so, they crowdsourced human judgments on 1,500 sentences with 137 verb complement constructions using as labels a 5-point Likert scale, and compared these judgments with those made by BERT. Their results and analysis are quite thorough, and led them to conclude that although BERT was able to replicate many of the human judgments, there is still significant room for improvement. Important from this work is also their explanation on the different perspectives that veridicality and factuality studies can have: lexical semantics or sentence meaning approach, and pragmatic or speaker meaning approach. But before explaining their definition of these approaches, we should go over the work

of de Marneffe et al. [1].

The study of de Marneffe et al. [1] is a main reference to this thesis. Their goal was to identify some of the linguistic and contextual factors that shape reader’s veridicality judgments. To do so, they present crowdsourced annotations on a part of the FactBank corpus with the same set of labels minus one, CTu, and a system for veridicality assessment. For our purposes, the two most important parts of their work is the consideration of the possible occurrence of label split and the comparison they made between their annotations and the original FactBank’s annotations.

In order to see if there is a possibility of label split, they studied the plotted distribution of agreement patterns. After discarding the likely noisy patterns, they observed that there are many examples for which it is unlikely that the agreement pattern is due to noise. For example, for the premise *In a statement, the White House said it would do “whatever is necessary” to ensure compliance with the sanctions.*, the judgment depends heavily on the speaker’s previous knowledge about the White House.

The comparison they make between the two set of annotations is very important because it shows quantitative differences between what they called, a lexical approach and a pragmatic approach. They do not define in detail the **lexical approach**, but they do mention that in such approach the context in which we study the factuality of a proposition is a lexical item. Ross and Pavlick [10] extends this definition by adding that a system following it should aim to model the aspects of a sentence semantics, thus, this representation can be derived from the lexicon and is independent of context, and also, as stated in Saurí and Pustejovsky [5], such a system would not consider world knowledge. Thus, linguistic experts are usually the ones who annotate the data.

As to the **pragmatic approach**, approach used by de Marneffe et al. [1], by Ross and Pavlick [10], and here, it requires the system to derive a representation of the sentence that considers the communication intent for that sentence in a specific context, that is, a goal-directed representation of a sentence within the context it was created [10]. Such a representation entails two important things: the consideration of world knowledge, and the embracing of uncertainty [1]. To obtain this representation a key step is to collect annotations from linguistically naive workers, so for examples (1a) to (1d) they would consider any knowledge they might have about John, Anna, and her father; and they would ignore any notions as to what *to say* is *supposed* to mean, and instead just use

their linguistic intuition.

There are other two important facts to consider about these two approaches. The first one is that not everyone explicitly defines the approach they use, but it is often, if not always, possible to infer it. Considering this is very important, specially when comparing results from different studies. The second fact is how these approaches are referred to. de Marneffe et al. [1] and Ross and Pavlick [10] use the terms lexical and pragmatic, but Ross and Pavlick [10] also employs the terms sentence meaning approach and speaker meaning approach respectively. Furthermore, de Marneffe et al. [1] hints at the idea that the pragmatic approach is done from the reader's perspective, since we want to analyze what the reader understands, not what the author says, as in the lexical approach [5]. Some studies and tasks like FACT at the Iberian Languages Evaluation Forum (IberLEF) [11], make use of these terms, author's or reader's perspective, rather than semantic or pragmatic approach.

Now that we have seen the differences between a factuality and veridicality focus, and between a lexical and a pragmatic approach, we can go on to exploring another important topic in this thesis: mood in Spanish.

2.2 Mood in Spanish

Simply put, **mood** is the grammaticalization of modality [12, 13], and thus it has been traditionally related with the speaker's attitude towards an utterance [12, 14]. But, as stated in Real Academia Española [14], this notion is imprecise and more needs to be said in order to explain all the phenomena. Nevertheless, to avoid complicated theoretical discussions, here mood is just considered as the grammatical category that reflects the commitment of a speaker towards an utterance [14].

Since the commitment of the speaker usually takes form in different degrees [12], in most languages mood takes form in different subcategories, like the indicative, the subjunctive and the imperative in Italian, or the subjunctive and the conditional in Hungarian. For Spanish, as in Italian, nowadays most of the grammarians agree on the existence of three subcategories of mood¹: indicative, subjunctive and imperative. Since the imperative mood is out of the scope of this thesis, I would simply say that it is the mood mainly

¹For a diachronic review of the study of mood in Spanish see Calvo [15]

used to express commands. As to the indicative and subjunctive mood, the topic is not so clear.

Quite often, the indicative and subjunctive moods are defined in opposition to each other Lyons [12], and Spanish is not an exception. Some pairs of concepts that Real Academia Española [14] uses to describe this opposition are the following: certainty/uncertainty, reality/virtuality, actuality/non actuality and commitment of the speaker with the veracity of what is spoken/lack of commitment. So for example, in (2a), where the verb *estar* (to be) is in indicative, the reading that we get is that *it is a reality that Sofía was there to see it*. Contrary to this, in (2b), where the same verb, *estar*, is in its past perfect tense from the subjunctive, the reading is that *Sofía wasn't there, but we wish there was a world, a possible world, in which she was there*. But, as stated in Real Academia Española [14] and Sánchez-Jiménez [13], these oppositions do not always work well.

- (2) a. Sofía **estuvo** allí para verlo.
 Sofía **be.pst.pfv.ind.3sg** there to see.INF.it
 "Sofía was there to see it."
- b. ¡Si Sofía **hubiera estado** allí para verlo!
 if Sofía **have.pst.pfv.sbjv.3sg be.ptcp** there to see.INF.it
 "If only Sofía had been there to see it!"
- (3) a. Quiero suponer que **has preparado**
 want.PRS.IND.1SG assume.INF that **have.prs.ind.2sg prepare.ptcp**
 todo.
 everything
 "I want to assume that you **have prepared** everything."
- b. Siento mucho que se te
 feel.PRS.IND.1SG a.lot that itself you.DAT
haya averiado el coche.
have.prs.sbj.3sg break.down.ptcp the.M.SG car
 "I'm so sorry to hear that your car **broke down**."

For example, in (3a), where the embedded verb *preparar* (to prepare) is indicative, the reading for the event is *I want the fact that you have prepared everything to be a reality, but it might not be*; and, opposite to this, in (3b), where the embedded verb *averiarse* (to break down) is in the subjunctive mood, its reading is that *it is a reality that your car broke down and I feel sorry for that*. Does this mean that the above mentioned oppositions are useless? No, but it does imply that interpreting them too strictly would be a mistake, and that some complimentary considerations are necessary. In this regard, Villalta

[16] talks about an ordering relation between contextual alternative propositions as the cause for embedded propositions to be in the subjunctive mood, and Mejías-Bikandi [17] explains the contrast in terms of old and new information.

Specifically, Mejías-Bikandi [17] understood **old information** as the information that is pragmatically presupposed, or in other words, the information with which the speaker assumes familiarity. **New information** would be then the one that is not presupposed. Based on these definitions, he classifies **matrix verbs**, that is, verbs that take a verbal predicate as a complement, into two groups: those that introduce old information and those that introduce new information. Then he uses this classification to explain the distribution in mood in complements of different types of matrices. The indicative, he claims, is used when the matrix introduces new information, as in the case of mental matrices like *notar* (to notice); and the subjunctive is instead used when the matrix introduces old information, as in the case of comment matrices like *lamentar* (to regret). Furthermore, he uses this classification to explain the distribution of mood for the following phenomena: the negation of some matrix verbs and matrix verbs whose subject contain a quantifying expression such as *poco/a/s* (a bit/bits) or the adverb *solo* (only). Next, we will briefly go over the syntactic functioning of the indicative and subjunctive moods.

As stated in Real Academia Española [14], authors often talk about a **dependent** and an **independent mood**, the first one being the one that requires a grammatical inductor in order to appear, like in example (2b), where the conditional conjunction *si* forces the subjunctive in the verb *estar*; and the second being the one that does not need any grammatical element in order to appear in the sentence. This distinction mostly correlates with the subjunctive and the indicative moods, since the cases in which the subjunctive appears without depending on any inductor are highly restricted [14], and the preferred choice for most of the simple sentences is the indicative, even if in many induced contexts choosing the indicative mood is a requirement, as in example (3a).

An important characteristic of these induced contexts, is that the specific mood, let it be the indicative or the subjunctive, prompted by the grammatical inductor can be an imposition, like in examples (2b) and (3b), or a choice, as in examples (4a) and (4b), and this is what is called **mood alternation**. This last case is the main feature of the experimental analysis in this thesis, and as such, it will be explained in detail next.

2.2.1 Mood Alternation

As stated above, mood alternation is the phenomenon in which a particular mood is induced within a distinct structure, usually the subjunctive in nominal complements, but this induced mood is *optional*, that is, speakers use the structure with either the indicative or the subjunctive mood, as in the examples below. There we can see that the two sentences are almost identical, even the translations into English are the same², the only visible difference lays on the morphology of the embedded verb. *Tener* (to have) is in the indicative mood in (4a), and in the subjunctive mood in (4b). What causes this phenomenon? How is it interpreted by speakers?

- (4) a. El presidente no dijo que el
the.M.SG president.M.SG not say.PST.PFV.IND.3SG that the.M.SG
país **tenía** problemas económicos.
country.M.SG **have.pst.ipfv.ind.3sg** problem.M.PL economic.M.PL
"The president didn't say that the country **had** economic problems."
- b. El presidente no dijo que el
the.M.SG president.M.SG not say.PST.PFV.IND.3SG that the.M.SG
país **tuviera** problemas económicos.
country.M.SG **have.pst.ipfv.sbjv.3sg** problem.M.PL economic.M.PL
"The president didn't say that the country had economic problems."

Contrary to what we have seen in the previous section about the overall distinction between indicative and subjunctive, in mood alternation the difference is quite clear. As stated in Real Academia Española [14], Mejías-Bikandi [17] and Falk and Martin [19], the indicative is used when the speaker chooses to present the event as new information, and the subjunctive mood is used when the information is already part of the common ground. Thus, in example (4a), the fact that *the country has economic problems* is presented as something new to the speaker; and in (4b), the fact that *the country has economic problems* or that *the country doesn't have economic problems* is considered to be known by the speaker.

An important work on mood alternation is the study of Faulkner [18]. Her goals were to see if there are non-standard cases of mood alternation in verbal complements and if these acceptability is dialectal, to understand if the informativeness of the complements affects this acceptability, and if so, to see in which cases this happens. To fulfill these

²There are ways in which the difference between the indicative and the subjunctive can be translated into English, but given that they are not very obvious or common translations, I chose to make no distinction, as in Faulkner [18].

goals she collected acceptability judgments on 128 sentences, with and without context, of speakers from different Spanish varieties. For all the sentences the induced mood is the subjunctive and the alternative is the indicative.

The main idea from the results of this study is that mood alternation in verbal complements is a complex phenomenon in which different factors come into play. First of all, the type of complement, or in other words, the type of matrix verb, considerably affects the acceptability judgment. For example, desideratives don't accept the indicative in their complements, but negated epistemics do. Secondly, moods alternation seems to depend on the presence or absence and on whether the context is informative or not. Thirdly, she shows some dialectal variations which we will neither discuss nor forget here. Lastly, it should be noted that, despite the thorough analysis she presents, not all results could be explained, which shows that further research into mood alternation is needed. Next the specific mood alternation phenomena analysed in this thesis are presented.

The first type is the negation of the matrix verb, shown in (4a) and (4b). As stated in Real Academia Española [14], negation can induce the subjunctive in the verb of the nominal complement. Specifically, they say that the adverb *no* (no) induces the subjunctive mood in the complements of verbs of speech, perception, thought and believe; and they give examples of mood alternation for verbs of perception. Thus, for the pilot study, only these categories of matrix verbs were considered.

The second type of mood alternation phenomena is that of adverbs of doubt and possibility, exemplified in (5a) to (5d). As stated in Real Academia Española [14], adverbs of doubt and possibility such as *quizás* (maybe) or *probablemente* (probably), induce indicative or subjunctive within their own sentences, but the subjunctive mood appears only when the adverb precedes the verb and there is no pause between them, as in examples (5a) and (5b). To my knowledge, research on this topic is not abundant, thus I was not able to define what exactly that *pause* means, that is, if it is literally a pause like the one indicated by , and other elements can be in between, such as the subject as in examples (5c) and (5d); or if it means that the adverb must immediately precede the verb and that no element can be in between, as in examples (5a) and (5b). For the pilot study, the former option was assumed to be true, but knowing that it could *easily* be denied. Next the second feature analyzed in the pilot study is presented.

- (5) a. Quizás **dijo** la verdad.
 maybe **tell.pst.pfv.ind.3sg** the.F.SG truth.F.SG
 "Maybe s/he **told** the truth."
- b. Quizás **dijera** la verdad.
 maybe **tell.pst.pfv.sbjv.3sg** the.F.SG truth.F.SG
 "Maybe s/he **told** the truth."
- c. Quizás el presidente **dijo** la verdad.
 maybe the.M.SG president.M.SG **tell.pst.pfv.ind.3sg** the.F.SG truth.F.SG
 "Maybe the president **told** the truth."
- d. Quizás el presidente **dijera** la verdad.
 maybe the.M.SG president.M.SG **tell.pst.pfv.sbjv.3sg** the.F.SG truth.F.SG
 "Maybe the president **told** the truth."

2.3 Specificity

If we consider the dialog below we can see a very simple interaction in which *A* informs *B* about the location of a specific book. But that is not everything that is being communicated. If we look at the utterance that *A* produces, we can see that aside from the location of an entity, *A* is making reference to two entities: a specific book and a specific table. But what does referring to something mean?

- (6) A. *The book is on the table.*
 B. *Ok. Thank you.*

To **refer** to something is to point, pick up, or call up on an entity or set of entities [12] in the mind of the speaker [20]. In other words, when a speaker makes a reference, she presupposes the existence of an entity or set of entities, and connects a linguistic expression to it [21]. When the listener hears such expression, he tries to make that same connection by corroborating its existence in the physical context, linguistic context, and/or his memory. This is why, the study of referential expressions is intrinsically connected to existence [12], to the study of existential presuppositions; to the point that, as stated in García Murga [21], the study of existential presuppositions must be supported by the study of reference. Further clarifications about this relation can be seen in Lyons [12], García Murga [21] and Herrasti et al. [22].

Above we have mentioned that the book and table to which *A* refers are a specific book and a specific table. At first glance, this can be simply understood as a particular book and a particular table, but as Caudet [20] thoroughly explains, the property

of being specific has being applied to different concepts, which can lead to some confusion. Thus she puts together the different views on specificity and summarizes them into the following six criteria, criteria that can be used to classify referential expressions:

1. Existence of the referent in the extra-linguistic reality.
2. Identifiability of the referent in the extra-linguistic reality.
3. Extension indicated by the referential expression.
4. Existence of the referent in the discourse universe.
5. Identifiability of the referent in the discourse universe.
6. The expression points to a set of referents pragmatically delimited or chooses a subset of them.

Here we consider **specificity** in the sense of the fifth criterion, therefore when manipulating the specificity of a nominal phrase, we indicate that the identifiability of the referent in the discourse universe is what is being analyzed. In particular, here we manipulate it by modifying the amount and type of information given in the subject of the premise.

Regarding the type of information, two manipulations are performed: individual vs. collective nouns, and common vs. proper nouns. With the first one we are manipulating the amount of individual entities to which we are referring to. By using an individual noun (in singular) like *president*, we point to one single entity, whereas by using a collective noun like *government*, we point instead to a set of entities; thus when trying to identify the referent in the discourse universe, the set of possible referents the listener considers is different.

As to the second manipulation, common vs. proper nouns, we alternate who identifies the referent. When using a common noun like *president*, the speaker only identifies the set of possible entities to which our referent belongs to, therefore leaving to the listener the final determination of the particular referent. Contrary to this, when using a proper noun, the speaker *usually*³ points directly to an entity or set of entities. Therefore, by distinguishing between common and proper nouns we have two different ways

³For some exceptions on the common use of proper nouns see Caudet [20].

of identifying the referent: identification by the listener and identification by the speaker.

With respect to the amount of information, only one manipulation is considered: is the common noun in the subject modified only by a determiner as in *the president*, or are there any other complements that modify the noun as in *the president of the government*? By performing this manipulation, which here we denominate mixed, we are influencing the retrieval of the referent in a similar way as to the common vs. proper noun distinction since we are modifying the number of possible referents the listener considers. When we have a mixed noun phrase, this number is smaller than with an almost bare noun phrase, but bigger than with a proper noun, thus being a sort of middle ground between common and proper nouns and resulting in the following scale of number of possible referents: common > mixed > proper.

CHAPTER 3

PILOT STUDY

3.1 Design

The goal of this pilot study is three-folded. First, I wanted to crowdsource annotations on premise-hypothesis pairs to answer the research questions introduced in Chapter 1 and which are repeated below:

- RQ1.- In a complex sentence like examples (4a) and (4b), how does the mood alternation of the embedded verb that occurs due to the negation of the main or matrix verb affect the factuality value of the embedded event?
- RQ2.- In a simple sentence like examples (5c) and (5d), how does the mood alternation caused by an adverb of doubt or possibility affect the factuality judgment of the event?
- RQ3.- How does an individual subject, like the one in example (5c), affect the factuality judgment of the event?
- RQ4.- How does a subject that refers to a collective entity like *the government*, affect the factuality judgment of the event?

These questions yield the four experimental conditions: negation (RQ1.-), adverb or possibility (RQ2.-), individual (RQ3.-), and collective (RQ4.-). Furthermore, given the novelty of these conditions and my unfamiliarity with a study of these dimensions, the second and third goals of the study are to ensure the correctness of the experimental design and procedure, and to explore different possibilities of statistical analysis, so that in the final study the data is properly analyzed and represented.

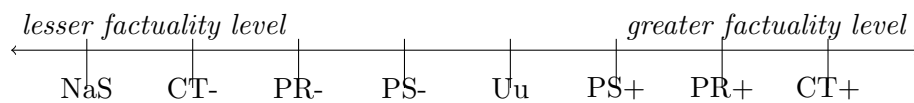


FIGURE 3.1: Ordered representation of the labels used for annotating the corpus. Each label stands for: certainly yes (CT+), probably yes (PR+), possibly yes (PS+), unknown or uncommitted (Uu), possibly not (PS-), probably not (PR-), certainly not (CT-), not a sentence (NaS).

If we take the four conditions, sort them into two groups, mood alternation for negation and adverb, specificity for individual and collective; and cross them, we obtain a 2x2 design, where each condition is divided into 3 subconditions or categories. The negation and adverb conditions are divided into three categories: baseline (B), where there is no negation of the matrix verb or presence of a doubt or possibility adverb, like in *El presidente dijo la verdad* (The president told the truth); indicative (I), where we have a mood induced adverb and the verb is in indicative mood like in (5c); and subjunctive (S), where we have a mood induced adverb and the verb is in subjunctive mood, as in (5d).

The specificity conditions are also divided into three categories: common (C), where the subject is a common noun with the determiner as its only complement as in *the president*; mixed (M), where the subject is a common noun but with a determiner and another complement like in *the Spanish president*; and proper (P), where the subject is directly a proper noun like *José Luís Rodríguez Zapatero* or there is a relation to a proper noun, like in *Ronaldinho's mother*.

As to the set of labels used to annotate each pair, I follow de Marneffe et al. [1] and used the labels from Saurí and Pustejovsky [5] minus *certain but unknown output* (CTu). But since, as mentioned in the previous chapter, I was not certain about the acceptability of sentences like (5c), where we have a nominal phrase between the adverb of possibility and the verb, I added another label, *not a sentence* (NaS), resulting in the following set of 8 labels, represented for simplicity as a one-dimension scale in Figure 3.1: certainly yes (CT+), probably yes (PR+), possibly yes (PS+), unknown or uncommitted (Uu), possibly not (PS-), probably not (PR-), certainly not (CT-), not a sentence (NaS).

3.2 Dataset

As to the dataset to be annotated, it was constructed by first writing 9 seed premises for each of the four baseline-common combinations and from them the hypotheses were extracted to form the pairs. Then these seeds were changed across conditions, yielding a total of 324 premise-hypothesis pairs¹. Table 3.1 shows this generation process together with the experimental design.

Data Generation within Experimental Design								
			SPECIFICITY					
			Individual			Collective		
			C	M	P	C	M	P
MOOD	Negation	B	S1	V1	V1	S2	V2	V2
		I	V1	V1	V1	V2	V2	V2
		S	V1	V1	V1	V2	V2	V2
	Possibility	B	S3	V3	V3	S4	V4	V4
		I	V3	V3	V3	V4	V4	V4
		S	V3	V3	V3*	V4	V4	V4

TABLE 3.1: Experimental conditions and corpus generation. Each cell is for 9 pairs. **S** followed by a number stands for set of seeds, **V** stands for variants, with the number indicating the corresponding set of seeds. * indicates where the 2 mistaken pairs are. **B, I, S** stands for *baseline, indicative, subjunctive*, and **C, M, P** stands for *common, mixed, proper*.

3.3 Predictions

Now that we the different variables considered in the study have been explained, we can try to envision how they will affect the annotations. As we can see in Table 3.2, the highest factuality labels are predicted for the baseline category, since in the absence of any of the mood inducing conditions, no other factuality modifier is expected, for the exception of the specificity categories. When combined with them, the factuality level of the baseline pairs might change, but only within the range specified in each case. This is because by modifying the amount of information (mixed category) or the type of information (proper category), it is expected that world knowledge, and thus uncertainty, plays a greater rol in assigning the label.

As to the other two mood categories, indicate and subjunctive, a decrease on the factuality level with respect to the baseline is to be expected, with the indicative having

¹Upon reviewing the pairs after the experiment was run, it was noticed that there was a mistake on 2 pairs, thus yielding them invalid. The whole two seeds were taken out for analysis, yielding a total of 306 analysed pairs.

Label Predictions within Experimental Design								
			SPECIFICITY					
			Individual			Collective		
			C	M	P	C	M	P
MOOD	Negation	B	CT+	CT+-PR+	CT+-PS+	CT+	CT+-PR+	CT+-PS+
		I	PR+	PR+-PS+	PR+-Uu	PR+	PR+-PS+	PR+-Uu
		S	PS-	PS+-PS-	PS+-PS-	PS-	PS+-PS-	PS+-PS-
	Possibility	B	CT+	CT+-PR+	CT+-PS+	CT+	CT+-PR+	CT+-PS+
		I	PR+	PR+-PS+	PR+-Uu	PR+	PR+-PS+	PR+-Uu
		S	PS+	PS+-Uu	PS+-Uu	PS+	PS+-Uu	PS+-Uu

TABLE 3.2: Rough approximation of label predictions for each combination of experimental categories. **B, I, S** stands for *baseline, indicative, subjunctive*, **C, M, P** stands for *common, mixed, proper*, and - indicates a range of labels when not indicating the quality of a specific label.

a higher degree of factuality than the subjunctive. Since by choosing the indicative mood the speaker presents the event, our hypothesis, as new information, she limits the possibilities of the listener belying the factuality of the hypothesis. Contrary to this, by using the subjunctive, the speaker assumes that the factuality of the event is already known and agreed upon, thus increasing the possibilities of it being denied, or in other words, she allows more uncertainty. These predictions for the indicative and subjunctive categories roughly hold for both mood alternation conditions, with the only difference being that for the negation condition, the factuality level for the subjunctive category is predicted to be lower than for the same category in the possibility condition, reaching even the level of the negative labels. This is due to the above-mentioned fact that only in this case the negation marker scopes over the embedded event, thus reducing the factuality of the event more strongly than a mere adverb of doubt or possibility.

Regarding their variability when crossed with different specificity categories, it is expected that labels within the indicative category will decrease in a similar fashion as to labels within the baseline category; but for the subjunctive category, barely any differences are expected since values in the subjunctive category are already within the range of high uncertainty.

Lastly, it should be noted that for most of the cases the labels predicted are within the positive range of the scale. In other words, the distribution of the labels is expected to be negatively skewed.

1.- Dado el contexto "RTVE no anunció que la periodista fuera a ser despedida." ¿Cree usted que el evento "La periodista iba a ser despedida."? *

☐ ciertamente ocurrió/ocurre/ocurrirá

☐ probablemente ocurrió/ocurre/ocurrirá

☐ posiblemente ocurrió/ocurre/ocurrirá

☐ no se sabe si ocurrió/ocurre/ocurrirá

☐ ciertamente no ocurrió/ocurre/ocurrirá

☐ posiblemente no ocurrió/ocurre/ocurrirá

☐ probablemente no ocurrió/ocurre/ocurrirá

☐ La primera oración es imposible en español.

FIGURE 3.2: Interface for the pilot study. The order here is: CT+, PR+, PS+, Uu, CT-, PS-, PR-, NaS. It should have been: CT+, PR+, PS+, Uu, PS-, PR-, CT-, NaS

3.4 Procedure

The annotations were collected through Google Forms. The first page of the form asked them to choose their variation of Spanish (European or American)², and the second one showed the instructions for the task, together with an example. It should be noted that these instructions might have been too simple, and that they should be elaborated more carefully for the final study.

After the second page, the pairs to be labelled were presented in 9 pages. Following de Marneffe et al. [1], the task consisted on questions where the labels were presented as answers in a single choice list. de Marneffe et al. [1] presented the labels ordered, but, as seen in Figure 3.2, in this study labels were by mistake not completely ordered.

Another important feature of this experimental procedure is that, since cognitive overload and an overly time-consuming task were to be prevented, pairs were divided into 9 batches, thus having a total of 9 forms with 36 pairs each. Initially, only 3 annotators were to annotate each pair, but as the task progressed, the lack of disagreement was noticed, and therefore two more annotators were added to each batch. That is, pairs were annotated by 5 raters, and each of them annotated 36 pairs.

²Given that the number of annotators for each group was completely different, this variable was not taken into account for the analysis.

With respect to the annotators, they were chosen among family and friends whose mother tongue is Spanish and who do not have higher linguistic education. This last feature was important in order to prevent annotations having a lexical approach, but, some of the annotators acknowledged afterwards that, since they attempted to find the *correct* answer, they had use their linguistic knowledge from their basic education instead of their *raw* linguistic instincts; hence this was acknowledge in the instructions for the final study.

Now that we have explained the study goals, design, predictions and procedure, we can present the statistical analysis of the annotations collected.

3.5 Results

3.5.1 Overview of the Annotations

In order to get a first understanding of the annotations, different plots were drawn and some very basic statistics were computed. These computations are shown in Table 3.3 and the two most relevant plots are shown below. Probably the two most important things to notice are that, as predicted, in Figure 3.3, where we have the overall distribution of labels, we observe that this distribution is quite negatively skewed, despite the considerable amount of pairs with a negation marker; and that the numbers of pairs for which agreement is reached is rather low, considerable lower than in de Marneffe et al. [1], where the percentage of pairs without a label was 22.118%. In that same plot we see that the differences between the negative labels is rather small, and that the Uu and PR+ labels are used with almost identical frequency.

In Figure 3.4, where the distribution of label per batch is shown, there is further evidence of a considerable lack of agreement, since several differences between the label distributions for each batch appeared, contrary to what was expected. For example, we see that batch B clearly uses the label CT+ more often than batch E, or that batches H and I seem to use the label NaS more often than the others.

Another important observation is the use of the label NaS. This label, mainly meant to be an insurance for the possibility condition, seems to be overused. This is evident in the fact that although NaS was used at least once in 10.457% of the pairs, no pair was labelled as not acceptable; and furthermore, 8 pairs in which this label was used, were

Basic Statistics		
	Absolute	Percentage
Total number of analyzed pairs	306	100
Total number of analyzed annotations	1530	100
Number of pairs without a label	121	39.542
Number of pairs with a label	185	60.458
Agreement equal to 3	112	36.601
Agreement greater than 3	73	23.856
Maximal agreement	18	24.657
Number of pairs with at least one NaS	32	10.457
Number of times NaS label was used	37	2.418
Number of baseline pairs in which NaS was used	8	25
Number of pairs with NaS labelled as NaS	0	0
Number of problematic seeds	8	23.530

TABLE 3.3: Some basic counts of the annotations. Maximal agreement means that the 5 raters agreed on one label. A problematic seed is one than has 5 or more of its variants without a label.

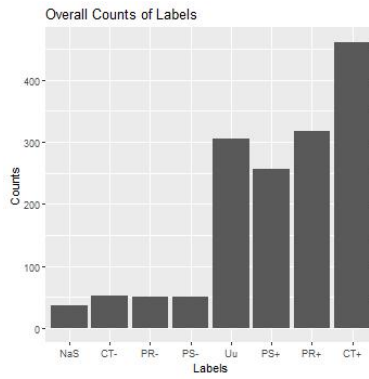


FIGURE 3.3: Overall distribution of the proportion of labels used by annotators.

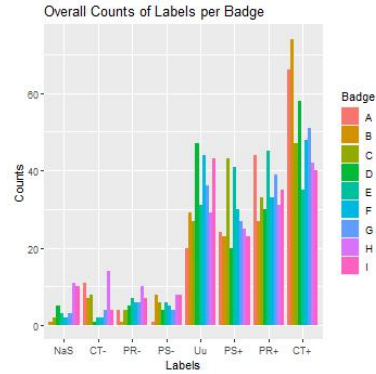


FIGURE 3.4: Distribution of the proportion of labels used by annotators grouped by batch.

baseline pairs, that is, pairs without any difficulty. Therefore the role of this label must be reviewed.

To sum up, in this section we have seen that, as predicted, the distribution of the labels is negatively skewed, with most of the counts being in the positive range of the labels' scale. We have also shown that the NaS label might have been misused in the annotations. Moreover, some indications of a considerable amount of disagreement in the annotations have been presented: the number of pairs in which at least 3 annotators agreed upon a label is lower than in the case of de Marneffe et al. [1] and the labels' distributions for each batch have some clear differences. In the next section we will see

the significance of this disagreement by measuring inter-annotator agreement.

3.5.2 Inter-Annotator Agreement Scores

Finding the score that correctly computes the inter-annotator agreement was a more complicated task than expected. Thus, instead of simply presenting one κ value to represent the inter-annotator agreement for the whole corpus, we present main values for different scores. All inter-annotator agreement scores computed for this study can be seen in Appendix ??.

Initially, I followed the work of de Marneffe et al. [1], and computed Fleiss' kappa [23], which resulted in a value of $\kappa^f = 0.160$, which means slight agreement according to the labels presented in Shrout [24], but since, as de Marneffe et al. [1] already remarks, this score does not consider the order between the labels shown in Figure 3.1, thus yielding an inaccurate value for this case, other possibilities had to be considered.

The main alternative is to use weighted kappa, a score that extends Cohen's kappa [25] to observations made using ordinal labels. For the case presented here, we would specifically need to extend the definition to the case of multiple raters and ordinal labels, task that is not without problems [26, 27] and thus it has different solutions. What all the different implementations have in common is defining κ as a relation between the weighted proportion of observed agreement p_{aw} , and the weighted proportion of chance agreement $p_{a|c_w}$ [28].

Here, initially the definitions presented in Warrens [29] and Warrens [30] were chosen, but after encountering the work of Vanacore and Pellegrino [28], this decision changed. Vanacore and Pellegrino [28] presents a theoretical analysis of four weighted kappas which differ in their definition of $p_{a|c_w}$, Fleiss [23] (κ_w^f), Conger [31] (κ_w^c), Brennan and Prediger [32] (s_w^*), and Gwet [33] (AC_2); as well as a comparison of their behaviours in paradoxical environments. Their results showed that both κ_w^f and κ_w^c were the most affected by these environments. So, given these results, the fact that κ_w^f and κ_w^c are, to my knowledge, more commonly used; and that, as seen in Figure 3.3, the distribution of our labels is skewed, or in other words, paradoxical; three different agreement scores were computed, κ_w^f , κ_w^c , and AC_2 , with the software package R, specifically the IrrCAC library [34]. Results are shown in Table 4.6.

Agreement Scores for the Whole Dataset	
Name	Value
Fleiss' κ	0.160
Fleiss' κ with linear weights	0.177
Conger's κ with linear weights	0.176
Gwet's AC_2 with linear weights	0.484

TABLE 3.4: Inter-annotator agreement scores computed for the whole dataset.

As we can see, all weighted scores show an improvement with respect to the unweighted Fleiss' κ , but only AC_2 clearly distinguishes itself from the kappa computed first. The other two weighted kappas are not just within the same range of slight agreement (0.11 – 0.40), but there are also barely distinguishable from the unweighted kappa. This could be interpreted as more evidence of very low agreement between annotators, but, given the already mentioned work of Vanacore and Pellegrino [28], that in 60.458% of the pairs at least 3 annotators agreed upon a label, and that the AC_2 has a value of 0.484, which is clearly within the range of fair agreement (0.41 – 0.60); it appears rather that these results can be taken as more evidence of the sensibility of κ_w^f and κ_w^c to paradoxical behaviour. Thus it seems appropriate to consider $AC_2 = 0.484$ as the inter-annotator agreement score that represents our corpus, but in order to strengthen this decision, the three weighted scores are used in any other computations presented here. Now we will briefly explore agreement within the experimental conditions.

3.5.2.1 Inter-Annotator Agreement for each Experimental Condition

Table 3.5 shows the value of the 3 inter-annotator agreement scores computed for the subsets of the corpus that correspond to each of the experimental conditions. Again we see what we saw above, Gwet's AC_2 is clearly greater in each case, and Fleiss' and Conger's κ are roughly equal, thus strengthening the decisions to use Gwet's AC_2 score. More importantly, based on these scores we can say that the difference between the specificity conditions is minimal, and therefore they are likely to be quite irrelevant as veridicality categories. Contrary to this, the difference between the mood alternation conditions is quite big, suggesting that they are suitable as veridicality categories. We will see afterwards if these ideas hold or not. Next we will present some simple computations done to explore the validity of the set of labels used.

Agreement Scores for Experimental Conditions			
Subset	κ_w^f	κ_w^c	AC_2
ALL	0.177	0.179	0.484
Negation	0.094	0.097	0.388
Possibility	0.278	0.278	0.592
Individual	0.161	0.162	0.500
Collective	0.190	0.192	0.470

TABLE 3.5: Inter-annotator agreement scores computed for the subsets corresponding to each of the experimental conditions. Values for the whole dataset are given as reference,

3.5.3 Label Space Reductions

In order to verify the validity of our label set, or in other words, to check if the low agreement score could be partially blamed to an inadequate label set, different label space reductions were performed, and the three weighted scores were computed for each of these reductions. The reductions are of two types: removal of any pair which was annotated with the label NaS, and merging of pairs of labels. By merging is understood the replacement of any instance of the first element of the pair with the second element, with the corresponding quality signs when required.

The results, shown in Table 3.6, display very interesting tendencies. First of all, the behaviours of the scores with the whole label set still holds: κ_w^f and κ_w^c are quite similar and within the range of slight agreement, and AC_2 is considerably higher and, for most of the cases, within the range of fair agreement. Secondly, we see that the scores are not always affected in the same way by the different reductions. Probably the best two examples are the *No NaS* and the *PR with CT, PS with Uu* reductions. In the first case we see that removing all pairs in which the NaS label is used benefits both κ_w^f and κ_w^c , but it has a detrimental effect on AC_2 . In the second case we witness the opposite effect happening. When reducing to the typical labels $\{yes, unknown, no\}$ (CT+, Uu, CT-), with or without NaS, it seems that it greatly benefits AC_2 , but that it diminishes both κ_w^f and κ_w^c . Thus, it appears that making radical decisions about the label set might be unwise. Nevertheless, it was considered that removing PS+ and PS- could be beneficial for the final study since scores increased in every case they were removed.

Next, the results of fitting a regression model to the annotations are presented.

Agreement Scores for Different Label Reductions			
Reduction	κ_w^f	κ_w^c	AC_2
ALL	0.177	0.179	0.484
No NaS	0.190	0.191	0.469
PS with PR	0.186	0.187	0.572
PS with PR, no NaS	0.204	0.205	0.537
PR with CT, PS with Uu	0.153	0.155	0.635
PR with CT, PS with Uu, no NaS	0.162	0.164	0.518
PS with Uu	0.204	0.205	0.590
PS with Uu, no NaS	0.224	0.225	0.550

TABLE 3.6: Inter-annotator agreement scores computed for the different label space reductions. *No NaS* means that all pairs in which any of the annotators used the label NaS were removed. For any pair of labels linked by the preposition *with*, the interpretation is that the first label was replaced with second one, with the correspondent quality signs when required.

3.5.4 Model Fitting

In order to understand how the different variables defined in Section 3.1 influenced the annotations, a cumulative link mixed model, was fitted with a logit link by using the R software, specifically the ordinal package [35]. As predictors, mood conditions were crossed with specificity conditions and mood categories, specificity conditions were further crossed with specificity categories, and mood categories were also crossed with specificity categories. Items and annotators were set as random intercepts, and the labels as the response variable. Here I only present the most relevant results, all details are in Appendix ??.

The most important observation is that most of the effects defined do not have a significant effect, only the mood condition adverb ($p = 2.31 \times 10^{-14}$) on its own, and crossed with the different mood categories ($p < 2 \times 10^{-16}$ for both the indicative and subjunctive category) have significant effects, which is consistent with the results in Section 3.5.2.1. Thus we can say that the mood conditions can predict a factuality label, and that for the mood condition adverb the mood categories play a significant role in predicting the label. As to the other predictors, there is one that is close to being significant, that of the crossed effect of the mood condition adverb with the specificity condition collective ($p = 0.054$), telling us that for the adverb condition, the specificity conditions might have a significant effect if the experimental design and procedure are improved.

The model threshold coefficients, also known as cut-points or intercepts [35] and shown in Table 4.11, represent the division of the *true* underlying factuality value for a premise-hypothesis pair. Thus they can be interpreted as the width of each category in the label

Model Threshold Coefficients			
Threshold	Estimate	Std. Error	z value
NaS—CT-	−4.254	0.326	−13.062
CT—PR-	−3.272	0.298	−10.962
PR—PS-	−2.756	0.291	−9.480
PS—Uu	−2.371	0.286	−8.277
Uu—PS+	−0.904	0.278	−3.249
PS+—PR+	0.006	0.277	0.023
PR+—CT+	1.233	0.279	4.415

TABLE 3.7: Threshold coefficients resulted from fixing a cumulative link mixed model the whole dataset with different combinations of mood conditions, mood categories, specificity conditions and specificity categories; and random intercepts for raters and premise-hypothesis pairs.

set, with the exception of our two extremes of the scale. Considering this and that, aside from the PR- and PS- labels, the space for each label is roughly similar, we can say that the labels are all informative. Given this, and the fact that the computations presented in the previous section were more an exploration than a proper statistical test, the proposal to remove the PS+ and PS- labels was not considered.

To sum up, from implementing a cumulative link mixed model I learnt that mood conditions and mood categories are informative to the experimental design, although not in all settings, and that the specificity conditions could have a significant effect when combined with the adverb condition. Hence it appeared reasonable to keep these three categories of variables for the final study, but not the specificity categories. Furthermore, given the threshold coefficients obtained, the proposal to remove the PS+ and PS- labels was no longer considered. Next, we will proceed to the final section of analysis of results where I will compare the annotations collected with the predictions.

3.5.5 Comparison with Predictions

Once we have obtained some numerical features of our annotations, we can dive into the data in order to examine whether the predictions were fulfilled, and what linguistic characteristics favoured or hindered agreement. To do so, I examine the labels assigned to each combination of the experimental conditions and categories presented in Table 3.8 and Table 3.9.

There are two main remarks to make about these tables. First of all, for the indicative category there is a higher factuality level than expected, particularly when crossed with

Assigned Labels within Experimental Design					
			SPECIFICITY		
			Individual		
			C	M	P
MOOD	Negation	B	CT+/PR+/Uu	CT+/PS-	PR+/Uu
		I	CT+	CT+	-
		S	?	CT+/Uu	-
	Possibility	B	CT+	CT+	CT+
		I	PR+/Uu	?	PR+/PS+
		S	PR+	-	?

TABLE 3.8: Assigned labels for the first half of each combination of experimental categories. **B**, **I**, **S** stands for *baseline*, *indicative*, *subjunctive*, and **C**, **M**, **P** stands for *common*, *mixed*, *proper*. The presence of a label/s or ? means that there were at least 5 pairs in in which 3 raters agreed upon a label, the opposite situation is indicated with -. ? means there was no majority vote for any label among the different pairs. / means that the votes were equally divided.

the negation condition and to the point that, in some cases, the label assigned to the indicative pair has a higher factuality label than for its correspondent baseline pair, although the distance between these labels is, in more cases, minimal. Furthermore, heeding the considerable lack of agreement and the consequential lack of pairs with a label, it seems that this difference between indicative and baseline pairs is consistent across all variants of the respective seed. Thus we can say that this difference might be due to some lexical characteristics. Further analysis into this phenomenon was left for the final study.

The second important observation is two-folded and concerns the labels assigned to the baseline pairs in the negation condition. First of all, we see a higher disagreement than expected, indicated both by the lack of variants to set a label for the combination and by the label split, in other words, that more than one labels is assigned, for half these combinations. Second of all, we see, in some cases, a lower factuality level than expected, to the point of uncertainty (Uu label). Determining the cause of these phenomena is not straightforward, but there is one helpful fact. Upon reviewing the data, it was noticed that one factor was not taken into consideration when defining the predictions: the matrix verbs.

Matrix verbs, that is, predicates that embed another predicate or event, have their own veridicality value, or, in other words, they have an effect on the factuality value of the predicate they embed. According to this effect, matrix verbs are classified into three groups: implicative, factive and epistemic. The first group designates the matrices whose embedded events are a consequence of the whole complex event, like *manage* in

Assigned Labels within Experimental Design					
			SPECIFICITY		
			Collective		
			C	M	P
MOOD	Negation	B	CT+	-	-
		I	CT+	-	CT+
		S	-	-	-
	Possibility	B	CT+	CT+	CT+
		I	PR+	-	?
		S	PR+/Uu	Uu	-

TABLE 3.9: Assigned labels for the second half of each combination of experimental categories. **B**, **I**, **S** stands for *baseline*, *indicative*, *subjunctive*, and **C**, **M**, **P** stands for *common*, *mixed*, *proper*. The presence of a label/s or ? means that there were at least 5 pairs in in which 3 raters agreed upon a label, the opposite situation is indicated with -. ? means there was no majority vote for any label among the different pairs. / means that the votes were equally divided.

He managed to sell the house. The second one denotes those whose embedded predicate is a fact or a precondition for the whole complex predicate, like *know* in *He knew her father had arrived*. Lastly, the group of epistemic verbs includes those whose embedded event is a possibility, like *think* in *He thinks that Peter has arrived*. An extreme case of how this distinction affects the baseline of our annotations are examples 7 and 8, whose assigned labels are CT+ and PS+ respectively.

- (7) a. La Razón sabía que la noticia
 La Razón know.PST.IPFV.IND.3SG that the.F.SG news.F.SG
 era falsa.
 be.PST.IPFV.IND.3SG fake.PTCP.M.SG
 La Razón knew that the news was fake.
- b. La noticia era falsa.
 the.F.SG news.F.SG be.PST.IPFV.IND.3SG fake.PTCP.M.SG
 The news was fake.
- (8) a. La junta directiva del Barça
 the.F.SG board.F.SG governing.F.SG of.the.M.SG Barça
 pensó que la reunión con los
 think.PST.PFV.IND.3SG that the.F.SG meeting.F.SG with the.M.PL
 abogados había ido bien.
 lawyer.M.PL have.PST.IPFV.IND.3SG go.PTCP.M.SGwell
 Barça's board of directors thought that the meeting with the lawyers had
 gone well.
- b. La reunión con los abogados había
 the.F.SG meeting.F.SG with the.M.PL lawyer.M.PL have.PST.IPFV.IND.3SG
 ido bien.
 go.PTCP.M.SGwell

The meeting with the lawyers had gone well.

In the first case, the matrix verb *saber* (to know) makes our hypothesis 7b a fact, or in other words, it assigns a high factuality value from our label scale, like *certainly yes*, to the pair. This assignation can surely be modified by other factors, but it definitely serves as a basic guideline to explain its behaviour with respect to the label of the pair below. In this second pair, the verb *pensar* (to think), is an epistemic verb, thus yielding 8b a possibility, and therefore assigning to it a more uncertain factuality value to begin with than for 7b. Furthermore, if we look at the other baseline variants from these pairs, we see more signs of this behaviour. In the case of 7, the other 2 variants have the same assigned label, CT+, whereas in the case 8, the other variants do not even have an assigned label. Given these differences, it will be prudent to consider their classification when defining the predictions and analyzing the data from the final study.

As to differences between the mood categories, there is not enough agreement to make clear conclusions, but some remarks can be pointed out. First of all, the distinction between the baseline and the mood alternation categories in the possibility condition is quite clear. All adverbial baseline combinations have a higher factuality value than the other two categories, but the distinction between indicative and subjunctive is not so clear. In the case of the negation condition, is more difficult to establish tendencies given the greater lack of agreement, but nevertheless, it seems that there is a difference between the three categories, although it is not clear how it works.

Further observations can be made about tables 3.8 and 3.9. The first one is that, consistent with the model estimates, the specificity categories do not appear to affect the resulting labels, thus it might be helpful to remove them from the final study. Contrary to this, it seems that the specificity conditions affect the labels, particularly in the negation condition and even if it is to cause more disagreement. Lastly, there might be some signs of a label split as seen in the baseline of the mood condition, but it could be due to the above mentioned issue of the matrix verb, and therefore more data and a more thorough analysis is needed.

To sum up, in this section I have presented evidence that can partially explain the unexpected values seen in the baseline category, also we have seen how there are some distinctions between the different mood conditions and categories, even if for the latter their significance of their effect is not yet clear. Likewise, there are a few signs of variations between the specificity conditions but not the specificity categories. Lastly, we

have also seen the overall need for a deeper linguistic analysis of the annotated pairs, analysis that I will present on the corpus of the final study.

3.6 Discussion

Throughout this chapter I have presented different results. Out of these one of the main results is the inter-annotator agreement, $AC_2 = 0.484$, that although higher than the initial chosen score, it is still lower than previous research on veridicality, with the work of de Marneffe et al. [1] having a $\kappa^f = 0.53$ and that of Saurí and Pustejovsky [5] having $\kappa^{cohen} = 0.81$, thus causes of this lower agreement need to be considered.

As already mentioned in Section 3.4, there are some factors in the experimental procedure that could have influenced the results. First of all, there was an important mistake: the labels were not presented in order. This could have prevented annotators from internalising the order behind the label set and thus made it more difficult for them to use it with ease. Second of all, the instructions might have not been clear enough given that at least a couple of annotators did not use their intuition as native Spanish speakers, but rather their basic formal linguistic knowledge; therefore I cannot say that these annotations were collected with a purely pragmatic approach but rather with a slightly mixed approach. Another reason why the instructions might not have been clear enough is that a couple of annotators reported the task to be quite difficult and at least one needed further clarifications. Given these important observations, the instructions for the final study were elaborated more thoroughly and more care was put into ensuring a correct experimental procedure.

An additional probable cause of the disagreement encountered might be the introduction of the label NaS. As shown in Section 4.6.1, even though this label was added as a mechanism to ensure the acceptability of the mood alternation pairs in the adverbial condition, given the high number of baseline pairs in which it was used and its very sparse distribution (no pair was labelled as *not a sentence*), this label was clearly misused. Considering this, and the fact that the NaS label does not completely fit into the scale shown in Figure 3.1, in the final study this label was not brought into the analysis and was used as a filter.

Even though I should aim to improve the experimental design and procedure to increase agreement among annotators, it should be noted that the *real* agreement is likely not too high due to several factors. First of all, the approach used here is a pragmatic approach and, as already stated, a pragmatic approach means embracing uncertainty [1], which translates into lower agreement scores than in other settings. Second of all, as stated in Section 2.2.1, mood alternation is a phenomenon that reflects different presuppositions made about the information presented, and therefore, it is classified as a pragmatic phenomenon rather than a semantic one. Consequently, even more uncertainty and the consequential greater disagreement should be expected from the annotations. Lastly, as the work from de Marneffe et al. [1] and that of Pavlick and Kwiatkowski [9] demonstrate, there appears to be cases in which the *true* label is split, that is, that to represent the judgments of speakers not one, but two labels are required. In this study I have not seen strong evidence that supports this idea, but as stated in Section 3.5.5, more and better data might prove this.

Regarding the validity of the experimental design used for this pilot study there are some changes that can be made based on the effects seen and on the believe that a simplification of the design will clarify the results and therefore ease their understanding. The main change was to remove the specificity categories (common, mixed and proper) given that no significant effect from them was detected in the model coefficients and no signs of possible effects were seen in the labels assigned. Another change was to remove the possibility condition. Even though it has proved to have a significant effect in the labels chosen, there are, to my knowledge, more resources and data for the negation condition, and also the tendencies seen in tables 3.8 and 3.9 are more compelling. Concerning the specificity conditions (individual and collective), even though there is no evidence to prove that they have a significant effect in the annotations, there are some signs of an influence that, with a better experimental procedure might become a significant or close to significant effect. Lastly, it was noticed in Section 3.5.5 that there was an important linguistic variable that was left out when defining the experimental desing of this study, that of the matrix verbs. Since this factor can clearly influence the results, it must be included as a variable in the final study, but its exact definition will depend on the data gathered to build the corpus. With this we accomplish the second goal of this pilot study, ensuring the correctness of the experimental design and procedure.

As to the third goal, exploring different possibilities of statistical analysis, I can now define the main steps to be used in the final study. First, I will examine the overall distribution of labels and the distribution of labels per batches, as well as calculate counts like those in Table 4.5, since all three have proven to be relevant to the posterior

computations of inter-annotator agreement scores. As to these scores, the only one to be used in the final study is Gwet's AC_2 since it has proven to better reflect the annotations collected and its implementation is settled. Lastly, given how informative the regression model has proven to be, a cumulative link mixed model will be fit to the data with probably a more thorough analysis of its characteristics. Aside from all this statistical analysis and as stated in the previous section, it should not be forgotten that what here was a very concise linguistic analysis, it needs to be more detailed for the final study.

Finally, concerning the first and second research questions, that is, whether the negation and possibility conditions affect the factuality of the embedded event, when existing, the main event otherwise; based on the evidence presented here it can be said that they do affect the label assigned to the event. Contrary to this, there is not enough evidence to respond our third and fourth research questions affirmatively, that is, we cannot say that our individual and collective conditions have a significant effect on the label assigned. But given the already mentioned problems in the experimental procedure, these answers should not be taken as final.

Next chapter presents the construction of the main or final study together with the analysis of the annotations gathered.

CHAPTER 4

MAIN STUDY

4.1 Introduction

In the first chapter four research questions were defined, and based on them the experimental design for the pilot study was created. But, given the results of this study and as stated in its discussion, the experimental design for the main study was simplified and therefore the research questions reduced to the following three:

RQ1.- In a complex sentence, how does the mood alternation of the embedded verb that occurs due to the negation of the main or matrix verb affect the factuality value of the embedded event?

RQ2.- How does an individual subject affect the factuality judgment of the event?

RQ3.- How does a subject that refers to a collective entity like an institution, affect the factuality judgment of the event?

From these questions we have the already known negation, individual and collective conditions; which can be grouped into specificity conditions (individual and collective) and mood alternation condition (negation). Furthermore, as in the pilot study the negation condition was divided into the categories baseline, indicative, and subjunctive, exemplified in sentences 9a to 9c. The difference for the specificity conditions is indicated by /.

- (9) a. El presidente/gobierno dijo que el
the.M.SG president.M.SG say.PST.PFV.IND.3SG that the.M.SG
país **tenía** problemas económicos.
country.M.SG **have.pst.ipfv.ind.3sg** problem.M.PL economic.M.PL
"The president/government said that the country **had** economic problems."

Experimental Conditions			
MOOD-Negation		SPECIFICITY	
		Individual	Collective
	Baseline		
	Indicative		
	Subjunctive		

TABLE 4.1: Experimental conditions for the final corpus.

- b. El presidente/gobierno no dijo que el
the.M.SG president.M.SG not say.PST.PFV.IND.3SG that the.M.SG
país **tenía** problemas económicos.
country.M.SG **have.pst.ipfv.ind.3sg** problem.M.PL economic.M.PL
"The president/government didn't say that the country **had** economic prob-
lems."
- c. El presidente/gobierno no dijo que
the.M.SG president/government.M.SG not say.PST.PFV.IND.3SG that
el país **tuviera** problemas
the.M.SG country.M.SG **have.pst.ipfv.sbjv.3sg** problem.M.PL
económicos.
economic.M.PL
"The president/government didn't say that the country had economic prob-
lems."

To obtain the experimental design, these conditions were crossed as in the pilot study, obtaining in this case a 3×2 design shown in Table 4.1. Although in Section 3.5.5 it was proved that the veridicality of the matrix verb affects the factuality of the embedded predicate and thus the label chosen by the annotator, it was decided not to include it directly in the experimental design but rather to annotate each pair with this information as it will be explained in the next section and tracked it closely in the analysis of the annotations. This was done to prevent a more complicated experimental design.

4.2 Dataset

Different sources were used to create the corpus. First, in order to directly compare results with the pilot study, we used all pairs from the negation condition. Then candidate premises were extracted from a section of the Daves Corpus del Español [36], the Old News Corpus for Spanish [37], *El Quijote* by Miguel de Cervantes (as found in Dario [38]), the XNLI corpus [8], and the United Nations corpus in Spanish for the years 2000, 2001, 2002, and 2003 [39]. The candidate premises were sentences in the indicative

condition whose embedded verbs were not in the simple future or conditional tense and they were found thanks to the LinguaKit [40]. After that the following modifications were done:

- Premises were shorten to be under 30 tokens, when necessary.
- Additional verbs in personal forms were removed.
- References were resolved when it was both needed and clear. There was at least one case in which it was needed, but it wasn't clear, and therefore a arbitrary substitution was made.
- Collocations like "to be a doubt" were not included.
- In a few cases where the verb was in first person (singular or plural) the agent was just put ahead of the premise in the following format: *Lotario: I think that the sky is blue.*"
- In one case the aspect of the embedded was changed to allow mood alternation since there are no simple forms in perfect aspect for the subjunctive).
- Adverbs modifying the matrix verb were removed.
- In a few cases, the subject was modified so the premise could be used both for individual and collective conditions.

Once these modifications were done, the hypotheses were extracted and the pairs were modified following the experimental design. Then different lexical, morphological, and statistical labels for each pair were gathered with the idea of maybe using them to extend the analysis of the crowdsourced annotations. The most relevant features gathered are the lexical items corresponding to the matrix and the embedded verbs, the veridicality value of the matrix verb, and person, number, tense and mood for both the matrix and the embedded verb. So for example (9a in either of the specificity conditions part of the information we have is the following: { matrix: decir, auxiliar: NaN, modal: NaN, veridicality: o/o¹, length_premise: 9}

It should be noted though that the distribution for most of these labels is quite spreaded and that the veridicality annotations, although done with the help of Stanford [41], are my own annotations and they do have a significant degree of uncertainty. Lastly, in order to obtain an overall view of the corpus, counts of these features and some basic

¹Neutral in affirmative and negative contexts.

Basic Corpus Statistics	
	Value
#pairs	524
Average premise length	15.004
Average hypothesis Length	9.539
Most Frequent Matrices	
<i>saber</i> (to know)	102
<i>creer</i> (to believe)	48
<i>considerar</i> (to considerate)	45
<i>decir</i> (to say)	36
<i>anunciar</i> (to announce)	36

TABLE 4.2: Some basic corpus statistics.

statistics were computed. Table 4.2 shows a sample of these.

4.3 Predictions

Given that several of the results obtained in the pilot study were unexpected and not completely explained, it was not consider important to define new detailed predictions and thus those from the pilot study, repeated with the needed adaptations in Table 4.3, were kept as guidelines for this experiment, although in this case deviations from them are certainly expected since, as mentioned in the previous chapter we know, for example, that verb matrices affect the factuality of the hypotheses.

Aside from these label predictions, it is important to remark that, while creating the corpus it was notice that some pairs could be *problematic*, that is, pairs for which disagreement or unexpected labels was considered possible. A deeper explanation of these factors will be given in Section 4.6.5, so for the moment just mention that some of the factors considerd are the nature of the hypothesis, like *Las mujeres son seres humanos* (women are human beings), indefinite determiners like *algunos* (some), and the type of utterance that the premise is, like assertions vs. questions.

4.4 Procedure

Annotations were collected on the platform Toloka [42] with the same labels as in the pilot study (see Figure 3.1). The interface used was similar to that of the pilot study

Label Predictions within Experimental Design				
			SPECIFICITY	
MOOD	Negation	B	Individual	Collective
			CT+	CT+
		I	PR+	PR+
		S	PS-	PS-

TABLE 4.3: Rough approximation of label predictions for each combination of experimental condition. **B**, **I**, **S** stands for *baseline*, *indicative*, *subjunctive*. The only difference from the pilot study is the removal of the no longer used possibility condition and the specificity categories.

Dado el contexto:

El director posiblemente desconocía el historial del actor.

Y el evento:

El director desconocía el historial del actor.

¿Cree usted que el evento ocurre/ocurrió/ocurrirá?

— ▾

FIGURE 4.1: Interface for annotations

Dado el contexto:

El director posiblemente desconocía el historial del actor.

Y el evento:

El director desconocía el historial del actor.

¿Cree usted que el evento ocurre/ocurrió/ocurrirá?

— ▾

- 1.- Ciertamente no
- 2.- Probablemente no
- 3.- Posiblemente no
- 4.- No se sabe
- 5.- Posiblemente sí
- 6.- Probablemente sí
- 7.- Ciertamente sí

La oración no es aceptable en español

FIGURE 4.2: Interface with labels

with the difference being that the labels were ordered from positive (CT+) to not a sentence (NaS). Figures 4.1 and 4.2 show how it looked like. Workers were paid \$0.433 per set of pairs, they were required to be Spanish speakers and were chosen among countries where Spanish is either an official language or one of the most important unofficial ones. Additionally, after the first sets of annotations were gathered it was decided to choose only top 50% annotators, and for the final sets, top 30% annotators. No batches were used since there was no way to ensure annotators did not cross between them, but pairs were gathered in sets of no more than 10, and annotators were allowed to skip them. As to the number of annotators per pair, we gathered as many as the budget allowed.

While running the experiment, annotations were reviewed with sets of submitted pairs. If the set was submitted too fast, like less than 50 seconds for 10 pairs, or if most of the pairs had the same label (9 out of 10 pairs, for example), it was usually rejected. Control tasks were not added since it was considered that they could lead annotators towards specific labels, or in other words, towards a lexical approach rather than a pragmatic one.

Use of NaS	
	Count
Total	66
# pairs	63
# pairs # NaS > 1	3
# NaS baseline	20
# NaS indicative	19
# NaS subjunctive	24
# NaS individual	36
# NaS collective	27

TABLE 4.4: Basic counts on the use of the label *not a sentence* (NaS).

Once all annotations were collected, following Pavlick and Kwiatkowski [9] all pairs which were labelled as *not a sentence* by at least one annotator were dropped and if a worker annotated more than 1 pair within a single combination of experimental conditions, all his annotations in that combination were removed. This left a total of 477 pairs and 7 annotators per pair. These are the annotations whose analysis is presented next.

4.5 Analysis of NaS

Before presenting the results of the corpus, I want to briefly see which sentences were excluded due to the use of the label NaS. Although there is previous work on discarding sentences which one annotator considers as not acceptable, given its unexpected use in the pilot study and the decision to change its use, I want to quickly see if there are any underlying patterns that could this rejection. Table 4.4 shows some counts of this label.

Even though for this experiment there was no explicitly construction whose acceptability I doubted and that the use of this label was explicitly discouraged in the instructions, it was still used in a considerable amount of cases, which suggests that it was a conscious decision. But, as in the pilot study, its use is quite spreaded across the pairs, which questions the exact reason as to why annotators used this label.

As to the distribution among experimental conditions, it was expected that the use of NaS would have a similar behaviour as to the disagreement found in the pilot study because it was assumed that non-acceptability is one of the causes of disagreement. But as we can see on the table, this does not seem to be the case. For example, in the pilot

study there was more disagreement in the collective condition than in the individual one, but here NaS used more frequently in the individual condition. More importantly, NaS was used quite frequently in the baseline condition, which should not be problematic.

In conclusion, not forgetting that the amount of data analyzed here is small and that the analysis itself is shallow, there seems to be no pattern that explains the use of the label *not a sentence* (NaS), thus it appears that there is no support to having this label or to using it as a filter. Next the analysis of the corpus is presented.

4.6 Results

4.6.1 Overview of the Annotations

Figure 4.3 shows the distribution of label counts for this experiment. As for the pilot study, the distribution is negatively skewed, but there are also some important differences. First of all, the frequencies for the negative labels are relatively higher than for the previous case. This is probably due to the removal of the possibility condition and the more diversified matrices. Another interesting distinction relating to the negative labels is the use of the label *certainly not*. In the pilot study negative labels were roughly equally used, at most, the use for CT- was slightly higher, but in this case, the use for this label is lower than the other negative labels. But more important is the situation of the *unknown or uncommitted* label, which, contrary to the previous case, is significantly lower than the positive labels. Lastly, it should be noted that here PR+ and PS+ are almost equal, suggesting that the review of one of the annotators of the pilot study (that he couldn't distinguish between them) is confirmed.

To further understand the overall features of the annotation some very basic computations, shown in Table 4.5, were done. Regarding the agreement patterns summarized by the counts of pairs with > 3 votes on one label or majority label, with a unique label but < 3 votes or most votes label, and without a unique label; they indicate that the inter-annotator agreement score is likely to be quite low, but since for 80% of the pairs there is 1 label, there might some underlying tendencies that the experiment has not flashed out. Lastly, it should be noted that how spread the number of annotations a worker does is. Next we will go over the inter-annotation agreement scores.

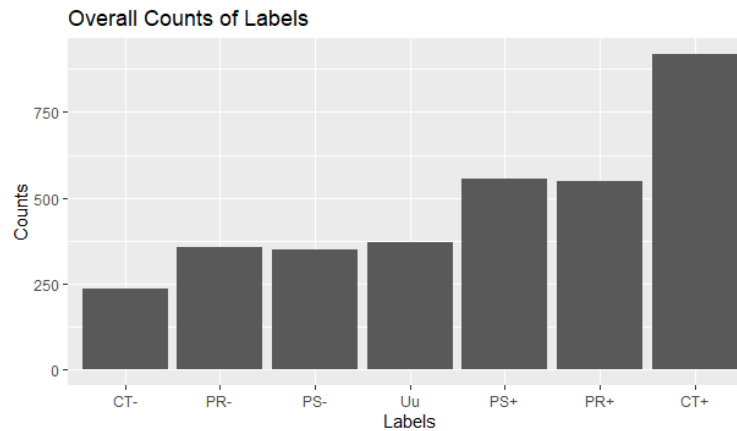


FIGURE 4.3: Overall distribution of the proportion of labels used by annotators.

Basic Statistics		
	Count	Percentage
Number of analyzed pairs	477	88.333
Number of dropped pairs	63	11.6
Number of analyzed annotations	3339	-
Total number of annotators	248	100
Average annotations per worker	13.464	-
Standard deviation annotations per worker	15.261	-
Maximum #annotations per worker	98	-
Minimum #annotations per worker	1	-
#pairs with > 3 votes on one label	195	41.139
#pairs with a unique label but < 3 votes	201	42.405
#pairs without a unique label	78	16.456

TABLE 4.5: Some basic counts of the annotations.

4.6.2 Inter-Annotator Agreement Scores

Overall the inter-annotator agreement score for the whole corpus is $AC_2 = 0.114$ which is barely within the range of slight agreement ($0.11 - 0.40$) [24] and which is far away from the pilot's study $AC_2 = 0.388$ for the negation condition. Given this, I decided to explore the value of Gwet's Ac_2 for different subsets of the corpus to try to find what causes such big disagreement. Subsetting by veridicality values or by specificity conditions did not yield very informative results, but, as seen in Table 4.6, subsetting by mood categories or by whether the pair was or not in the pilot gave some interesting results.

The biggest difference we see is between the baseline and the mood alternation conditions, there is a drop from fair agreement to virtually none ($0.00 - 0.10$), which can be considered as evidence that the baseline is well established. Nevertheless although

Inter-Annotator Agreement Score for Different Subsets	
Subset	AC_2
ALL	0.114
Baseline	0.194
Indicative	0.070
Subjunctive	0.085
Pairs in pilot study	0.080
Pairs not in pilot study	0.129

TABLE 4.6: Inter-annotator-agreements scores for the whole corpus and different subsets.

Inter-Annotator Agreement Score for Different Matrices	
Subset	AC_2
ALL	0.108
Top 5 most frequent matrices	0.123
Not top 5 matrices	0.093
<i>saber</i> (to know)	0.170
<i>creer</i> (to believe)	0.131
<i>considerar</i> (to considerate)	0.098
<i>olvidar</i> (to forget)	0.181
<i>ver</i> (to see)	0.022

TABLE 4.7: Inter-annotator-agreements scores for the whole corpus and different subsets by matrix verb. The 5 most frequent matrices are *saber* (to know), *creer* (to believe), *considerar* (to considerate), *decir* (to say), and *anunciar* (to announce).

considerably higher than for the whole corpus, the agreement for the baseline category is still lower than for the pilot study, which at least partially explains why for the other two conditions the score is quite low since mood alternation is a pragmatic phenomenon. Furthermore, the difference between the indicative and the subjunctive is minimal, which can be regarded as a sign that mood alternation does not affect the factivity of the embedded event.

A very puzzling result shown on the table is the difference between the pairs that were on the pilot study and those who were not. Since an important difference between the pairs in both studies is that the matrix verbs in the pilot are the standard matrices for mood alternation according to Real Academia Española [14] and those in this study are *natural occurrences*, the corpus was subsetting according to whether the matrix verb is standard or not, but the difference was minimal. Thus the difference between being or not in the pilot study probably does not have a straightforward explanation.

Aside from the already mentioned subsets, AC_2 was computed on different matrix verbs

Model Scores							
link	Threshold	Nobs	logLik	AIC	niter	max.grad	cond.H
logit	flexible	3339	-6179.67	12379.34	964(1997)	7.36×10^{-03}	1.4×10^{02}

TABLE 4.8: Cumulative link mixed model scores for the model representing the whole dataset.

subsets and the results are presented in Table 4.7. At first, I suspected that rare matrices could cause disagreement and therefore divided the corpus into two groups: pairs whose matrix verb is one of the 5 most frequent ones (*saber* (to know), *creer* (to believe), *considerar* (to considerate), *decir* (to say), and *anunciar* (to announce)) and the other the rest. This yielded a small difference in the score that I explored even further with specific matrices with different frequencies. By doing so, it was proved that the variations seen with different matrices are not due to the frequency of the matrix but rather to the matrix itself. For example, *saber* (to know) has a frequency of 102 and an AC_2 score of 0.170, but, *olvidar* (to forget), whose frequency is 24, and even of *creer* (to believe, 48), has an AC_2 of 0.181. In conclusion, it seems that the lexical nature of the matrices influence agreement. Next, I present the results of fitting a cumulative link mixed model (CLMM).

4.6.3 Model Fitting

Several CLMMs with the label as an outcome variable were fitted for both the whole dataset and the datapoints corresponding to the indicative and subjunctive categories. Annotator and premise-hypothesis pair were set as random effects, with the former varying within the difference models and the latter showing much greater model variability. As predictors the mood condition, the specificity condition, the different matrix values, and the different veridicality values were used. Predictors were either single or crossed. Maximum number of crossed predictors was 4. AIC values differ, but not greatly: for the whole dataset values were all between 12300 and 12500, with differences smaller than 120; for the indicative-subjunctive dataset values were between 8300 and 17500. Conditional Hessian values range from 10^2 to 10^5 .

From these different models there are some important observations than be made. First of all, it seems that the specificity conditions complement other predictors in a few cases, that is, they grade their information rather than being informative on their own. Secondly mood appears to be more relevant than specificity since it can yield significant effects, but when combined with other predictors it seems to grade them or completely

Model Coefficients			
Coefficient	Estimate	Standard Error	$\Pr(> z)$
MOOD _C CONDITION: indicative	-0.372	0.083	8.32×10^{-06}
MOOD _C CONDITION: subjunctive	-0.438	0.084	1.71×10^{-07}

TABLE 4.9: Cumulative link mixed model coefficients for the model representing the whole dataset.

disappear. More importantly, for the subset corresponding to the indicative and subjunctive categories there is only one case in which mood has a significant effect: for the matrix verb *olvidar* (to forget). That is, there is a difference between the baseline and the mood alternation conditions, but not between the latter, suggesting that the mood alternation phenomenon in its negation instance does not affect the factuality of the embedded verb significantly. Lastly, given the high conditional Hessian values and the low pair variance reached with the predictors already mentioned, adding more from the information gathered from each pair would be a mistake.

To represent the whole dataset, a model with the formula $\text{LABEL} = \text{MOOD_CONDITION} + (1 \mid \text{ANNOTATOR}) + (1 \mid \text{ID})$ was chosen and its main results are presented in tables 4.8 to 4.11. This model was selected based on the scores presented in Table 4.8 and given that the mood conditions are one of the main variables of this study. Adding the specificity conditions proved to be non-informative and adding the matrices increased both AIC and the conditional Hessian matrix considerably, which was suspected to happen due to their sparse distribution. A similar effect in a lesser degree occurred with the conditional Hessian matrix when adding the veridicality values, and since these values are also quite sparsely distributed, this model was also dismissed.

Table 4.9 presents the model coefficients. Both indicative and subjunctive are significantly different from the baseline, thus showing that overall the baseline is well established. Furthermore, both coefficients are negative and rather small, proving the notion expressed in the experiment's predictions on Table 4.3: the factuality of the hypothesis decreases with the negation of the matrix and that overall there is a difference between having the embedded verb in the indicative or in the subjunctive mood. With respect to this difference, it is not so surprising that the models fitted only to the indicative and subjunctive conditions proved insignificant given that the difference between the coefficients in Table 4.9 is < 0.1 .

From Table 4.10, which presents the random coefficients of the model, the most interesting result is that both random effects are considerably lower than for the pilot study

Model Random Effects			
Groups	Name	Variance	Std.Dev.
PAIR	(Intercept)	0.101	0.318
ANNOTATOR	(Intercept)	0.010	0.101

TABLE 4.10: Cumulative link mixed model random effects for the model representing the whole dataset.

Model Threshold Coefficients			
Threshold	Estimate	Std. Error	z value
CT—PR-	-2.910	0.089	-32.564
PR—PS-	-1.851	0.072	-25.534
PS—Uu	-1.239	0.067	-18.453
Uu—PS+	-0.723	0.064	-11.238
PS+—PR+	-0.027	0.063	-0.425
PR+—CT+	0.724	0.064	11.301

TABLE 4.11: Cumulative link mixed model threshold coefficients for the model representing the whole dataset.

(0.512 and 0.505 respectively). Given the ample disagreement found in this study, one could have expected for it to be reflected in these random variables. In other words, if there was a lot of noise in the data due too a poor collection in the annotations, this would have been meant a lot of variance in the annotator variable. Since this is not true, it seems that the experimental procedure is acceptable and that what should be improved is adding more predictors that could reduce the pair variance. A more balanced corpus could probably solve this.

As to the model threshold coefficients presented in Table 4.11, we can see that the spaces estimated for each label roughly range from (0.5 – 1.2), which means that they are closer than in the pilot study, where distances had a rough range of (0.3 – 1.5). Furthermore, the thresholds here are closer than previously and the differences between negative labels and positive labels have reduced. These three facts together suggest that the label space works better for this corpus than for the previous one.

Lastly, in order to understand whether the sparsed distribution of the matrices explains why they do not work well as a predictor, the same model and a model that adds matrix as a predictor were fitted to the subset with the five more frequent matrices where matrix frequencies range from 36 to 102. AIC values were almost identical and the model with less predictors had a smaller value for the conditional Hessian matrix. Nevertheless, for the second model the conditional Hessian value was reduced for more than a 100 and more significant effects ($p < 0.05$) were yielded. This confirms what was mentioned

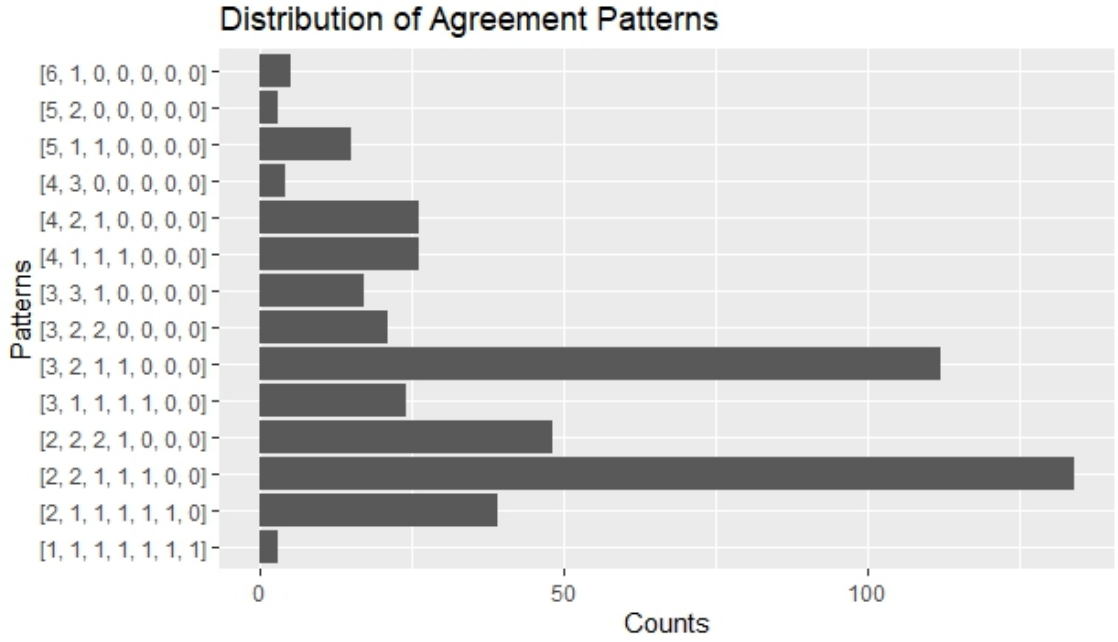


FIGURE 4.4: Distribution of agreement patterns.

above: with a more balanced corpus more predictors than explain the pair variance can be added.

Next, an analysis of the different agreement patterns is presented. In other words, an analysis of how votes in each pair are distributed is presented.

4.6.4 Agreement Patterns

Given the amount of disagreement found in this study, it seems futile to try to do as in the pilot study and generate a table with the assigned label/s per each combination of experimental combinations. Thus it was decided to instead explore the agreement patterns and see what information they can yield.

Figure 4.4 shows the distribution of the different agreement patterns found in the corpus. Although there is a considerable amount of patterns that occur less than 25 times ($< 6\%$), there are some patterns which occur with significant frequency which show the lack of agreement measured by the overall AC_2 score. Among these, there are two patterns that more than double the frequencies of the other agreement patterns, $[3, 2, 1, 1]$ and $[2, 2, 1, 1, 1]$, and thus they cannot be disregarded.

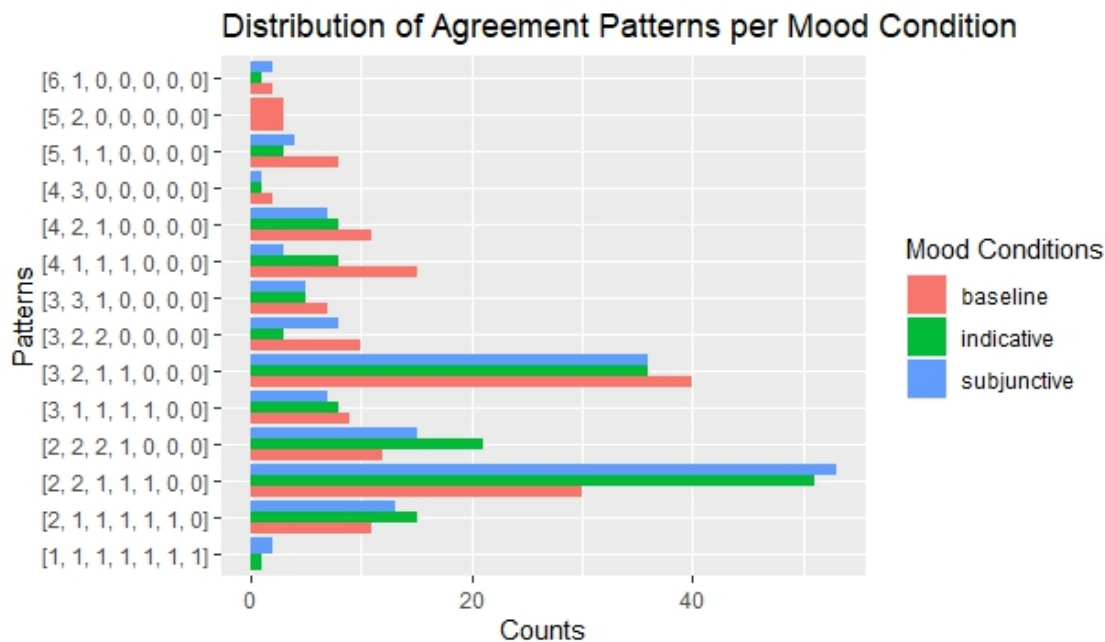


FIGURE 4.5: Distribution of agreement patterns per mood condition.

If we look how the agreement patterns are distributed per mood condition (Figure 4.5), we can see that there are some differences, although the picture is not quite clear, and that the results are consistent with the agreement scores in Table 4.6 since within each pattern, pairs are more often in the baseline condition for the patterns that represent greater agreement and the indicative and the subjunctive more often for the more scattered patterns. Specifically, the baseline condition has the highest frequency from [6, 1] to [3, 1, 1, 1, 1], and the indicative and the subjunctive are in close competition in patterns from [2, 2, 2, 1] to [1, 1, 1, 1, 1, 1, 1]. This suggest that the pairs in the indicative and subjunctive might be better represented with 3 labels, but for the pairs in the baseline condition frequency seem to suggest that 2 label are needed to represent them, which is quite unexpected.

It is quite surprising that there is such a considerable amount of disagreement for pairs that do not have the main linguistic markers in this study, neither negation adverb nor mood alternation. It is true that given this lack of agreement is not surprising that the overall agreement is barely within the range of fair agreement. Given this, it is worthwhile to look closer at this condition to try to understand what happened. To do so, we look at all baseline pairs which *negar* as a matrix verb, 6 in total. Out of these, there is majority agreement for only one pair, three have an agreement of the type most votes, and two do not have an agreement upon unique label. We focus on these last two pairs.

Pair (10) seems to be in the real of uncertainty (PS+ to PS-) since the two most voted labels are PS+ and PS- with two votes each, and there is only one vote for a certainly label, specifically CT+. Having negative labels (3 in total) is expected since in positive environments *negar* (to deny) makes the embedded predicated a contradiction. As to why the judgments lean towards uncertainty more than to negative certainty there are two factors that might have some influence: reference solution and the relativity associated with the embedded predicate. Regarding the first factor we have two unresolved references, *su* (his/her) and *esas* (those) that could have caused the workers to wonder whose government and which dispositions is the premise referring to, and thus made the judgment about the factuality of (10b) more uncertain. As to the second factor, *dejar mucho que desear* (to leave much to be desired) is an at least partially subjective expression since what one desires often depends from person to person. Thus when assessing the truthfulness of the hypothesis is likely that the annotators added another layer of uncertainty but, contrary to the previous one, I believe this one depends more on the annotator and more than explaining the uncertainty, it explains the lack of agreement, whereas the layer caused by the reference markers could the most voted labels being PS+ and PS-. But of course, a more thorough analysis is needed to validate this hypothesis.

- (10) a. Su Gobierno niega que la
 His/her/its.SG government.M.SG deny.PRS.IND.3SG that the.F.SG
 aplicación práctica de esas disposiciones
 application.F.SG practical.F.SG of that.F.PL disposition.F.PL
 deja mucho que desear.
 leave.PRS.IND.3SG much that desire.INF
 His/her Government denies that the practical application of those dispositions leaves much to be desired.
- b. La aplicación práctica de esas disposiciones
 the.F.SG application.F.SG practical.F.SG of that.F.PL disposition.F.PL
 deja mucho que desear.
 leave.PRS.IND.3SG much that desire.INF
 the practical application of those dispositions leaves much to be desired.
- (11) a. Israel niega que en el ejercicio de su
 Israel deny.PRS.IND.3SG that in the.M.SG exercise.M.SG of his/her/its.SG
 derecho inherente a defenderse del terrorismo
 right.M.SG inherent.SG to defend.INF.REFL from.the.M.SG terrorism.M.SG
 más brutal debe actuar dentro de los límites
 most brutal.SG must.PRS.IND.3SG act.INF inside of the.M.PL limit.M.PL
 del derecho internacional.
 of.the.M.PL law.M.SG international.M.SG

Israel denies that in the exercise of its inherent right to defend itself from the most brutal terrorism must act inside the limits of international law.

- b. En el ejercicio de su derecho inherente a
 in the.M.SG exercise.M.SG of his.her.its.SG right.M.SG inherent.SG to
 defenderse del terrorismo más brutal Israel
 defend.INF.REFL from.the.M.SG terrorism.M.SG most brutal.SG Israel
 debe actuar dentro de los límites del
 must.PRS.IND.3SG act.INF inside of the.M.PL limit.M.PL of.the.M.PL
 derecho internacional.
 law.M.SG international.M.SG

In the exercise of its inherent right to defend itself from the most brutal terrorism Israel must act inside the limits of international law.

As to pair (11) the situation is quite different. To begin with we have a 3-way split between PS+, PR+, CT+; which, considering the already mentioned behaviour of *negar* (to deny), is quite surprising. In this case we do not have any unresolved references or subjective predicates, but there is an embedded deontic modal predicate, *debe actuar* (must act), which makes the entire hypothesis an obligation [43] and thus making its acceptance or rejection less certain. In other words, the presence of the deontic modal could be the cause of the label split. As to the reason behind most of the labels being in the positive range, it is likely to be the world knowledge associated with the utterance since usually accept the rule of international law, even when having to defend yourself. Consequently overridden the effect of the matrix verb. More examples of how world knowledges affects judgments are presented in the next section.

The analysis presented for pairs (10) and (11) is obviously not enough to explain the amount of disagreement found in the baseline category, but it provides some evidence that there are other factors that complicate what was supposed to be a *simple* assessment. A more thorough and formal analysis is left for future work.

Lastly within this section we have Figure 4.6, which presents the distribution of agreement patterns according to the two specificity conditions: individual and collective. The overall picture appears to be quite confusing with not a very clear sign of for which condition there is more agreement. By distributing the agreement patterns according to their agreement type (majority, most votes, not unique), we see that there are more pairs in the collective condition that have majority agreement, that is, one label with at least 4 votes. But, given that patterns of type most votes (one label has most of the votes but less than 4) are more often in the individual condition, and that in the pattern with the highest frequency there are clearly more pairs in the collective condition, we

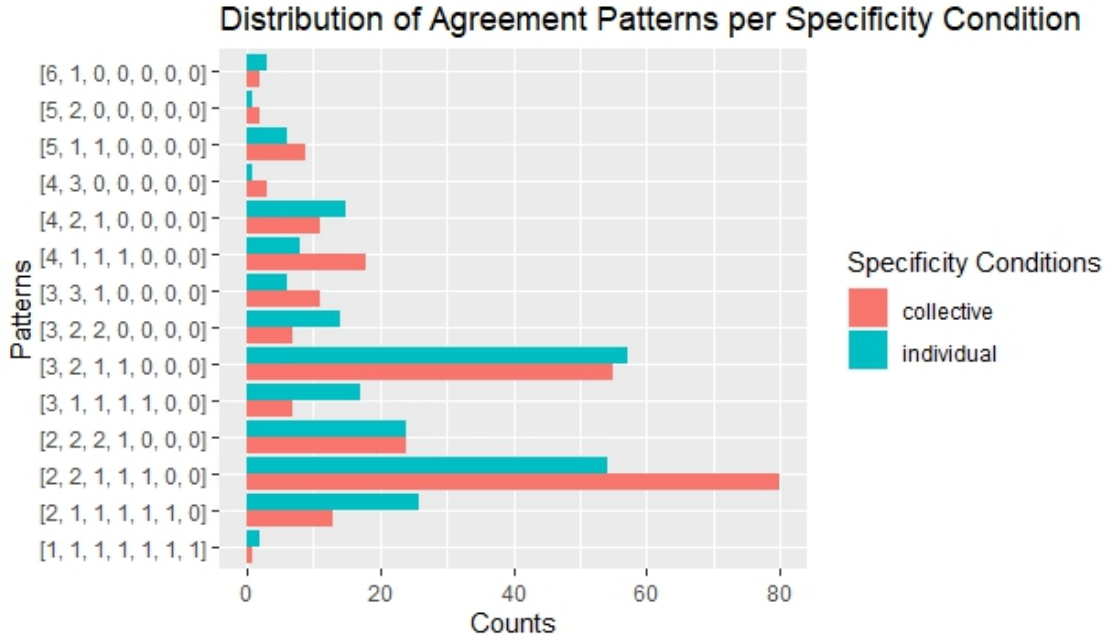


FIGURE 4.6: Distribution of agreement patterns per mood condition.

cannot confirm the observation made in the pilot study that disagreement was higher for the collective condition. Figure 4.6 rather shows that there are no big differences between the specificity conditions.

4.6.5 Manual Analysis

The goal of this section is to take a closer look at the annotations gathered to search for more causes of disagreement and to see if the *problematic* pairs mentioned in Section 4.3 are indeed problematic or not. Before analyzing the pairs it should be noted that to avoid long lists of glossed examples only pairs in the baseline conditions, that is individual or collective seeds, are represented here; that given the results on the specificity conditions not much attention will be paid to them, and more importantly, that this analysis is only exploratory. A systematic analysis is left for future work.

In the entire corpus no seed was found that *literally* fits the predictions made in Table 4.3, but there are some examples that show small variations between the different mood conditions and a few are close to the predictions. The best example is the pairs represented by seed (12), which were labelled as CT+, PR+, and PS+, with 4, 3, and 5 votes respectively. The matrix verbs for these pairs, *anunciar* (to announce), is neutral in both affirmative and negative contexts, that is, the premise neither entails nor

contradicts the embedded predicate no matter the polarity of the whole sentence. This, together with the absence of any other linguistic markers that could interfere with the mood conditions and that it is unlikely that the hypothesis generates strong presuppositions or implicatures, explains the lack of strong deviations from the predictions.

- (12) a. La familia anunció que
 the.F.SG family.F.SG announce.PST.PFV.IND.3SG that
 había recortado gastos.
 have.PST.IPFV.IND.3SG cut.down.PTCP.M.SGexpense.M.PL
 The family announced that they had cut down expenses.
- b. La familia había
 the.F.SG family.F.SG have.PST.IPFV.IND.3SG
 recortado gastos.
 cut.down.PTCP.M.SGexpense.M.PL
 The family had cut down expenses.

Regarding the label assigned for the subjunctive condition is interesting because it suggest that the effect of the negation adverb is not very strong, less than expected. Although a more thorough analysis to fully understand if indeed the impact of *no* (not) in this context.

A very interested example is (13), for which the label CT+ was assigned in each of the conditions with more than 3 votes, more specifically with 4, 6, and 6 votes respectively. That is, on average the factuality of the event *las mujeres son seres humanos* (women are human beings) is not modified neither by the negation of the matrix verb nor by the mood alternation of the event itself. It is true that this could be explained by the fact that *saber* (to know) implies the embedded predicate in both affirmative and negative contexts, but given that not all pairs that have this matrix verb have these labels, it is likely that the deciding factor is the knowledge associated to the hypothesis. The event represented in the hypothesis is a state whose negation or even just uncertainty is not likely to be accepted in many societies nowadays. In other words, it is likely that the world knowledge of (many of) the speakers overrode all linguistic factors at play.

- (13) a. Algunos delegados gubernamentales saben que
 some.M.PL representative.M.PL governmental.M.PL know.PRS.IND.3SG that
 también las mujeres son seres humanos.
 also the.F.PL woman.F.PL be.PRS.IND.3PL being.M.PL human.M.PL
 Some governmental representatives know that women are also human beings.

- b. Las mujeres son seres humanos.
 the.F.PL woman.F.PL be.PRS.IND.3PL being.M.PL human.M.PL
 Women are human beings.

Another good example of how world knowledge affects the factuality judgments is pair (14). In the baseline and indicative conditions this seed received a majority vote for CT+ with 4 votes in each case, and votes for the subjunctive condition were split between PR- and CT+ with 2 votes each. Aside from being in the collective condition and in the respective mood conditions, we have on one hand *negar* (deny), which contradicts the embedded predicate if it is not negated, as a matrix verb, and on the other hand we have *poder* (can), which puts both *negar* and the embedded predicate in the realm of possibilities. Nevertheless, it seems that for most of the annotators neither of these factors were significant, instead I suspect that their world knowledge overrode them since *los jóvenes tienen relaciones sexuales* (young adults have sexual relationships) is often considered an undeniable fact. However, it appears this *universal truth* is not shared by most of the annotators since the same number of annotators that consider the hypothesis as an undeniable fact in the subjunctive condition labelled it as *probably not*. That is, world knowledge can override linguistic features but it is difficult to determine when it is going to happen.

- (14) a. Los gobiernos pueden negar que los
 the.M.PL government.M.PL can.PRS.IND.3PL deny.INF that the.M.PL
 jóvenes tienen relaciones sexuales.
 young.adult.M.PL have.PRS.IND.3PL relationship.F.PL sexual.PL
 The governments can deny that young adults have sexual relationships.
- b. Los jóvenes tienen relaciones sexuales.
 the.M.PL young.adult.M.PL have.PRS.IND.3PL relationship.F.PL sexual.PL
 Young adults have sexual relationships.

In Section 4.3 it was mentioned that some of the pairs in the corpus were questions. Specifically, two seeds were added in the individual condition with certain concern. This concern came because it was assumed that questions would add another level of uncertainty to an already uncertain ground. Thus we will now see what the annotations for these pairs are.

The seeds for these questions are presented in examples (15) and (16). Both pairs are quite similar since they have the same matrix verb *saber* (to know) in the same tense and aspect, the embedded events are states of different nature but in the same tense,

and they even have the same adverb *acaso* (by any chance) modifying the matrix verb. But what is more interesting is that, with the exception of (15) in the subjunctive condition, neither of the variants agree upon one label, although the number of splits and the labels in which they split are different.

- (15) a. ¿Acaso sabe el Sr. Bustani que Israel
by.any.chance know.PRS.IND.3SG the.M.SG Mr. Bustani that Israel
está armado hasta los dientes con armas
be.PRS.IND.3SG arm.PTCP to the.M.PL tooth.M.PL with weapon.F.SG
nucleares y con las aeronaves y los tanques más
nuclear.PL and with the.F.PL aircraft.F.PL and the.M.PL tank.M.PL more
avanzados?
advance.PTCP.M.PL
Does Mr. Bustani know, by any chance, that Israel is armed to the teeth
with nuclear weapons and with the more advanced aircrafts and tanks?
- b. Israel está armado hasta los dientes con
Israel be.PRS.IND.3SG arm.PTCP to the.M.PL tooth.M.PL with
armas nucleares y con las aeronaves y los
weapon.F.SG nuclear.PL and with the.F.PL aircraft.F.PL and the.M.PL
tanques más avanzados.
tank.M.PL more advance.PTCP.M.PL
Israel is armed to the teeth with nuclear weapons and with the more advanced
aircrafts and tanks.
- (16) a. ¿Acaso sabemos todos que cada persona
by.any.chance know.F.SG everyone that each.F.SG personF.SG
es un microcosmos?
be.PRS.IND.3SG a.M.SG microcosmos.M.SG
Do we all know, by any chance, that each person is a microcosmos?
- b. Cada persona es un microcosmos
each.F.SG personF.SG be.PRS.IND.3SG a.M.SG microcosmos.M.SG
Each person is a microcosmos.

In the baseline condition (15) was splitted into PS+/PR+ and (16) into PR-/Uu/CT+, in both cases with 2 votes per label. Given the already mentioned confusion between probability and possibility, the split in the first case is not surprising; and if to that we add the uncertainty assumed for these questions, the chosen labels are both acceptable and explainable. As to the second case is definitely unexpected, but when looking directly at the hypothesis (16b), it seems that it might be cause of the disagreement. *Cada persona es un microcosmos* (each person is a microcosmos) is a statement of a philosophical nature, thus some people consider it an *undenniable* truth while others might negate its factuality. Either way, I hypothesize that this kind of events generate

strong presuppositions that are more likely to override linguistic markers than other types of events.

As to the results for the other two conditions of the seed (16), the explanation holds since the range of labels used is the same, although the splits change. Regarding the variations for (15), there is more variation. In the indicative condition we have again a 2-2 split, but instead we have the labels *Uu* and *CT+*. For the subjunctive condition there are no splits at all, instead we have a majority agreement for *CT+*. The only reasonable explanation appears to be that there is a *struggle* between the linguistic markers and workers' knowledge about the truthfulness of *Israel está armado hasta los dientes con armas nucleares y con las aeronaves y los tanques más avanzados*. (Israel is armed to the teeth with nuclear weapons and with the more advanced aircrafts and tanks.), and in the subjunctive condition annotators favoured the factuality of this hypothesis, which I know to be considered an undeniable truth by some, over the linguistic markers, similar to the results for (14).

Regarding the pairs with indefinite determiners, specifically with *algunos* (some), there were no clear patterns found overall. If they cause uncertainty, it seems that it is in a lesser degree in comparison with questions, since only 2 pairs out of 12 had splitted labels. It is true that only 3 pairs reached a majority agreement, but the labels do not reflect a clear lack of confidence in the judgments, specially with the results already explained for seed (13).

The last factor that could be considered a cause of disagreement was the presence of a modal verb. Initially this was thought mainly for modals modifying the matrices, but after seeing the results for pair (11), it was decided to examine the pairs where there is a modal verb in the embedded predicate. There are 30 pairs of this type and for half of them there is not unique label upon which annotators agreed on, a percentage quite higher than the overall 16.456%. Furthermore, 4 out of these 15 pairs were splitted into three labels. Thus, it appears that the presence of a deontic modal like *deber* (must) causes disagreement. But of course a more thorough analysis is needed to confirm this hypothesis.

4.7 Discussion

Throughout this chapter different results have presented that complet the picture drawn by the pilot study. First of all, results showed a persistent use of the label *not a sentence*, despite been explicitly discouraged. Even though as seen in Section 4.5, it was not used the same way as in the pilot study, its persistent use suggests that it conscious and that there are pairs which speakers do not accept.

Secondly, in Section 4.6.1 we have seen that, with a few differences like the use of the label *unknown* (Uu) and the higher frequencies for the negative labels, the overall distribution of the labels here is like the one for the pilot study: negatively skewed and with positive labels being used more often than negative ones.

Thirdly it was shown that the inter-annotator agreement score for this is corpus is quite different from that of the pilot study, from $AC_2 = 0.484$ to $AC_2 = 0.114$, or from fair agreement to slight agreement. But evidence was given that suggests (TO BE COMPLETED: short summary of results with few comparison with pilot, barely anything of purely discussion.)

In the next and final chapter the results of both studies are brought together to give a final answer to the research questions and to discuss what could have been done better and what is left for future work.

CHAPTER 5

CONCLUSIONS

5.1 Summary of Results

Bring together results of pilot and main, quite similar to Section 4.7.

5.2 Answer to Research Questions

As already mentioned a couple of times, the research questions of this thesis are the following three:

RQ1.- In a complex sentence, how does the mood alternation of the embedded verb that occurs due to the negation of the main or matrix verb affect the factuality value of the embedded event?

RQ2.- How does an individual subject affect the factuality judgment of the event?

RQ3.- How does a subject that refers to a collective entity like an institution, affect the factuality judgment of the event?

Based on the results obtained from the two studies we can now give clearer answers than the ones initially given in Section 3.6. First, the answer for questions RQ3.- and RQ2.- is quite clear: Having an individual subject vs. having a collective barely affects the factuality of the embedded event. In other words, the specificity of the subject in terms of the number of entities to which they refer in singular is non-veridical.

As to the first question the answer is slightly more complicated. From the results obtained in both studies we know that overall affects the factuality of the embedded

predicate, but this effect is not significant. It appears though that a more detailed analysis based on matrix verbs and probably even in other factors like the presence of modal verbs might show significant effects in a few specific cases. In other words, the veridicality of mood alternation is bigger than that of specificity as analyzed here, but it is still rather small.

5.3 Disagreement

Comparison with other studies. How much agreement can we really get? Discussion of one label vs distribution applied to this case. Details to be decided.

5.4 Improvements

After running and analysing both studies, there is a need to reflect on the decisions made not with the idea of *improving agreement*, but with the aim of obtaining clearer results. First of all, given that it was proven that the effect of mood alternation depends upon the matrix verbs and that when not controlled it is difficult to fully its effect, it is likely that corpus balanced not just in terms of mood but also in terms of matrices could have provided more understandable results.

An important topic in the area of improvements is that of data quality both when gathering the annotations and when postprocessing them. First of all, it was decided not to add training or testing for the annotators in fear that it would preset them towards specific answers. After seeing the results of the study and encountering the work of Nie et al. [44], where they used carefully crafted training and testing that did not fully prevented disagreement, it is understood that training and testing could have been implemented, although it would have been a difficult implementations within the size of this corpus.

Secondly, it is true that rather than defining the rejection criteria before running the study, they were specified as the annotations were encountered and not with a lot of confidence. For example, it was clear that annotations done *too fast* had to be rejected, but the problem was defining what exactly too fast meant and even more, what about annotations that took *too long*? Another conflicting decision was determining when

labels were misused. It was clear that if a set of annotations had been done relatively fast and had all, or almost all the same label they had to be rejected. But what if they were done in a *timely manner* but still had the same label? The rejection criteria should have indeed been defined beforehand, but also some references in this matter were and are still needed.

Thirdly, in terms of postprocessing there is certain confidence in the decisions made, but there is room for improvement. On the main study pairs which were labelled as *not a sentence* were removed, but contrary to what was done in the pilot study, whole seeds were not removed. This was done to prevent losing too much data, but it is true that there is no evidence to support this decision. Furthermore, a constant question when analyzing the annotations was whether there are more filters that could be applied and how to measure their effectiveness. Thus it can be said that other filters could have improved the results.

Lastly, after seeing the results of both studies and seeing the amount of different labels used it is clear that the assumptions must be revised. Specifically about the of negating the matrix verb. It was assumed that the negation of the matrix verb implied that the embedded predicate would be negated, even if not with complete certainty. But as seen in Section 4.6.5, this is not always the case. Thus it could have probably been better to first study the effect of negation and then of mood alternation.

5.5 Future Work

Throughout these pages two studies have been presented and their analysis focus more on what the data looks like (AC_2 , CLMMs, etc.) than on why does it look like that. Only a few possibilities, like the influence of world knowledge and the possible effect of modal verbs, that could explain the results have been given. Thus, a main of future work would be a thorough analysis of the data in terms of explaining how the annotations look like.

A second line of work is complementing the analysis of the annotations with scores that do not assume that there is a single label that represents each pair. For example, Nie et al. [44] use the entropy of the distribution over human annotations to examine human agreement and Gordon et al. [45] use both inter-annotator and intra-annotator measures

to detangle disagreement.

An important question that was raised while designing the main study was the inclusion of out-of-sentence context in the corpus. This seemed reasonable given the results of the pilot study and that, as Faulkner [18] shows, both the presence and the informativity of the out-of-sentence-context influence the acceptability of mood alternation. Furthermore, since in Section 4.6.5 it was demonstrated that the difficulties in reference resolution might have increased disagreement and uncertainty in the chosen labels, context could have solved this problem. But, given the results of Pavlick and Kwiatkowski [9] where it was shown that disagreement increased with context, it is difficult to predict how agreement would have looked like if context had been added. Furthermore, as already mentioned, Faulkner [18] shows that the informativity of the context matters, thus, adding it would have complicated an experimental design already difficult enough. Nevertheless, given the lack of studies in NLI that include context, it is definitely a line of research that needs to be developed, specially since a pragmatic approach should include context, and sentence context is not enough to fulfill this.

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